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ABSTRACT

These user instructions and related materials are designed to accompany a series of twenty-three applied physics modules which have been developed for postsecondary students in electrical, electronics, machine tool, metals, manufacturing, automotive, diesel, architecture, and civil drafting occupational programs. The instructions include an overview of the applied physics project, a program description, explanation of the module format, suggestions for management and usage of the materials, instructional notes for each individual module, and a set of student directions explaining the individual components of the modules. Test forms, answer keys, and data sheets are also included. (All twenty-three modules are available in ERIC document CE 014 409. Certain modules from the total set are available separately for courses in the following technologies: manufacturing engineering, machine tool and design, welding, and industrial plastics--CE 014 410; architectural and civil drafting--CE 014 411; and automotive and diesel--CE 014 412.) (BM)

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ED150309

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CE 014 408

Southeast Community College--Milford Campus, Milford, Nebraska 68405

Applied Physics Module

SOUTHEAST COMMUNITY COLLEGE—Milford Campus Milford, Nebr. 68405

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Applied Physics Module

SOUTHEAST COMMUNITY COLLEGE—Milford Campus Milford, Nebr. 68405

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INTRODUCTION

Applied physics modules were designed for self study in an individualized applied physics course in postsecondary vocational-technical education. Mathematical requirements are at the pre-calculus level. The instructor will find helpful suggestions for the management of the program in these notes. Additional suggestions may be found in the references.

A total of 57 modules have been developed for students in electrical, electronics, machine tool, metals, manufacturing, automotive, diesel, architecture and civil drafting occupational programs. Of the 57 modules there are 23 different subjects in the areas of mechanics, properties of matter, heat, wave motion, sound and light. A complete list appears on page 5 of this booklet. The subject matter of each module is given in the appendix.

The 57 modules are equivalent to the content of two quarters of a 5-credit hour class for electrical-electronic and manufacturing-metals technologies; a 5-credit hour class in transportation technologies and a 3-credit hour class in construction technologies.

OBJECTIVE

The objective of this project was to design and test student learning packages for applied physics for postsecondary vocational-technical students which would: (1) improve student achievement in applied physics, (2) increase student perception of relevance of applied physics to their chosen occupational field. This was accomplished in two primary ways: by constructing learning activities for physics which have direct applications to the future skill or trade of each student and by providing alternative student learning experiences as part of the delivery methodology for each physics module.

PERSPECTIVE

Many postsecondary vocational-technical students perceive little or no relevance for instruction which does not have direct application to their chosen area of occupational preparation. Courses in applied mathematics, business communications, applied physics and other trade-related courses expecially have little interest to the student.

Problem solving involves logical, analytical and deductive reasoning. It carries over into the technical skills required for such jobs as troubleshooting an engine and analyzing a complex

electronic circuit. Industrial consultants, who meet in an advisory capacity with technical instructors each year at Milford, have stressed the need for greater emphasis on mathematics and science in the instructional program to insure that future students will be able to solve problems on the job.

Physics is often stressed in the pre-interview aptitude tests by some larger employers. The aptitude tests are sometimes standardized physics tests used strictly as a test of the student's knowledge of physics. Students who score well on them usually qualify for the better jobs offered by those employers. Therefore, applied physics courses are considered an important part of the vocational-technical curriculum at Milford.

The problem was that generally, the average and below-average student did not achieve well on tests and exhibited an apathetic or negative attitude toward physics in the classroom. Applied physics courses have been taught at Milford by the traditional lecture/demonstration method. The hypothesis of this project was, therefore, that if the technological application of each physics principle as it directly relates to the future skill or trade of each student is made known to the student before he/she begins each learning module, the student's attitude toward learning that module will be positive. In addition, if alternative student learning experiences are made available to the student using hands-on experiences, multi-mediated, and individualized approaches to learning, students will score higher on achievement tests than the students in the existing program.

FORMAT

Each module is standardized in format for easy student understanding. The paper materials include a spiral bound booklet and some looseleaf materials. The booklet includes:

1. Cover pages printed on card stock
   a) Module number and title
   b) Contents. (Identifies subject matter)
   c) Program. ((Identifies the students who use the module). The color of the cover also identifies the same group:
      i. green - electrical-electronic classes
      ii. blue - manufacturing and metals classes
      iii. yellow - automotive-diesel classes
      iv. salmon - architectural-civil drafting classes
   d) Purpose. (Tells the student why the subject is important to him)
   e) Producers name and date.

2. White pages
   a) Objectives
   b) Directions for using the self evaluation test
   c) Learning Activities (for achieving the objectives)
      i. Reading (keyed to 5 textbooks and information sheets)
      ii. Listening/Viewing (film and tape listing)
      iii. Performing lab experiments
      iv. Others (reports, tours, etc.)
   d) Directions for taking the module test.

3. Pink pages
   a) Self-evaluation test
   b) Answer key with Question-Learning activity cross references.

4. Green pages
   a) Information sheet. (this includes text information on the module subject that is not included in one or more of the 5 textbooks.)

5. Ivory pages
   a) Applied physics problems. The first few problems are general questions about the subject while all others are applied directly to the students chosen technology.
   b) Answer key to problems.

6. Yellow pages
   a) Laboratory experiment. This contains detailed proceedure directions for the student to accomplish the experiment with minimum help from the teacher.

7. Orange pages
   a) A few modules have the directions for writing a short report.

The module bookelts are bound with six different colors of spirals. This keeps the booklets from getting mixed up in the storage area.

Looseleaf materials include:

1. Pink pages
   a) Five versions of the module test. These are of the same design and difficulty as the self-evaluation test in the booklet.

2. Blue pages
   a) Lab data sheet keyed to the lab instruction in the booklet.

3. Cherry pages
   a) Answer key for the tests. These may be bound in an answer key booklet for use in grading the tests.

In addition the the above material, there is an instruction booklet for the student telling him how to use the modules.

APPLIED PHYSICS MODULES.

		Electronics	Manufacturing	Transportation	Construction
M 2	Sizing Things Up	X	X		X
M 3	The Nature of Vectors	X	X		X
M 4	Static Equilibrium	X	X		X
M 5	Movin' On (Motion	X	X		X
M 6	Friction	X	X	X	X
M 7	Laws of Motion	X	X		X
M 8	Energy and Power	X	X	X	
M 9	Simple Machines	X	X	X	
M 10	Circular Motion	X	X	X	
M 11	Power Transmission	X	X	X	
M 12	Single Harmonic Motion	X	X		
P 1	Mechanical Properties of Matter	X	X		
P 2	Fluids I (Static)	X	X	X	
P 3	Fluids II (Dynamics)	X	X	X	
P 4	Molecular Properties of Matter	X	X		
T 1	Temperature and Expansion	X	X	X	
T 2	Heat and Change of State	X	X	X	
T 3	Heat Transer	X	X	X	
W 1	Wave Motion	X			
W 2	Interference of Waves	X			
W 3	Sound Waves	X			
W 4	Illumination	X			
W 5	Electromagnetic Waves	X			

RESULTS OF TESTING

See appendix

THE TECHNICAL PHYSICS COURSE

Various courses, based on applied physics modules have proved to be satisfactory as an introductory physics course for technicians. Technical courses have requirements different from regular arts and science courses. The course for diesel technology may have a different emphasis than that for electronics technology, for example. Some technologies may require a one quarter course; others two.

You can pick and choose the modules that the technology requires from the course. Some modules, of course, should be taken in order while others can be taken any time. A two quarter course will include all of the modules.

With students working individually, a mixing of students from various technologies (in a single class) creates no extra problems. Even a mixing of students with different mathematical abilities creates fewer problems than in traditional courses. In a self-paced course, those students with weaker math backgrounds can get individual help as they need it. Upon completion of a given module, students advance individually to the next one.

MANAGEMENT OF THE INDIVIDUALIZED COURSE

Traditionally, large classes always require a number of assistants. Some are in charge of the recitation section, others manage the labs, and some grade the homework. Together, they grade the tests.

In self-paced classes, you will find about the same number are needed. The number depends entirely on the size of the class. A general rule is one assistant for every 15 students. A small class of 20 or fewer students can be handled by the instructor without assistance.

Some of the assistants can be utilized as proctors to help with homework, to monitor and grade tests, etc., with a certain group of students assigned to each one. Some might be in charge of lab equipment and monitor the lab experiments.

There are a variety of approaches to managing a self-paced physics course. The tasks required of you and your assistants are

1. Pretesting
2. Assigning learning activities
3. Helping individuals with homework
4. Supervising the class-lab room and storage center
5. Monitoring and grading tests and keeping records
6. Solving general management problems
7. Getting things ready to go

Each task is discussed below and will suggest some of the possible approaches.

PRETESTING AND ASSIGNING LEARNING ACTIVITIES

Each student may take the self-evaluation test included in each module to assess his/her comprehension of the module content. Some students feel more comfortable if the instructor evaluates the test and assigns learning activities accordingly; others may take the test on their own and decide what learning activities to complete.

The first method is very time consuming, especially if many students in the class select this option. The second method encourages self-study but students may omit some crucial portions of the module. A third method allows the student to judge most matters for himself but he/she is required to hand in the completed lab data sheet and the solutions to a few teacher-selected problems before being allowed to take the test on that module. "Hand-in" requirements can be listed on the course outline described later. See appendix II.

The single-concept films, tapes and other audio-visual materials that are available at your institution can be listed on the course outline, also. When new films are added to your library or learning resource center the course outline will have to be altered before the next class begins.

The laboratory experiment can be used as presented in the module if you have the same equipment available. Detailed instructions are given so the student will take up little or none of the instructors time while he is performing the experiment. If you have locally produced lab instructions for other experiments, this should, also, be noted on the course outline. If the lab section is entirely separate from the rest of the class, the instructions can be given orally.

Some modules (M-10 and 11) outline a report you may wish the student to write. Again, note this on the course outline as a requirement that must be completed before he/she takes the module test.

Module M 11 includes a guided tour of various dynamometers usually found in vocational-technical college shops. Students can learn a great deal about power measurements from such a tour, especially if you can remove covers to show the brake mechanism, the heat exchangers and the transducer system which provides the power or torque read-out. Even better, arrange with the shop teachers to have one of them in operation. Such a guided tour should be arranged for small groups of students who have completed the experiment on this module.

MANAGING THE CLASS-LAB ROOM AND STORAGE CENTER.

You must provide the students with a place to do the various activities, including consulting with an instructor about difficult points in homework, performing experiments, viewing films and taking tests.

Small classes can be handled by the instructor alone. If there are 15 to 25 students, it might be possible to hire a student (for a grade) to help other students with homework or other time consuming tasks. Naturally, the student must have some background in physics.

The following suggestions are oriented toward larger classes in which two or more assistants are required.

HELPING STUDENTS WITH HOMEWORK

When students have difficulty with homework problems, they will need guidance from you or one of your assistants. After the first few weeks, the students will have spread themselves out in the course. Some will lag behind a module or two; others will be several modules ahead. Thus, a separate recitation class for giving homework assistance is not very efficient. Instead, a corner of the class-lab room or a separate room needs to be reserved for individual help with one or more assistants available acting as tutors.

MANAGING THE LABORATORY

The equipment for the laboratory experiments (for each module) should be stored in separate boxes, compartments or drawers. They should be located where they can be picked up, carried to a lab bench, used and returned to storage. Assistance may be required to answer questions about the experiment itself, though. Naturally, lab stands, balance scales, meter sticks and other equipment used in several different experiments can be stored separately. They should however, be placed where students will have easy access to them.

MULTI-MEDIA LISTENING/VIEWING

A place for viewing the single-concept films or other media materials must be made available. Study carrels, equipped with projector and screen, can be set up in one end of the class-lab room or in a separate room. If these facilities are available in the Learning Resource Center, the films can be viewed there outside of class time. If the LRC is used, you need to give the students a tour at the beginning of the course. Show them how to use the projectors.

PRODUCING TESTS

Testing is required for each unit. Short-answer easily-graded tests are most desirable, however, strict problem type tests can be used if your philosophy requires it. In either case, the tests should be based on the objectives as they are stated in each module booklet. They should measure the things the unit objectives say the students should be able to do.

Accompanying each module is a set of five tests similar in design and difficulty as the self-evaluation test. Additional tests may be produced by taking about two questions from each of the five. Inform the students of the type of test you are going to use early in the course if you decide to use other tests.

MONITORING TESTS

The actual testing can be accomplished and monitored at tables or desks near one end of the room. This section should be reserved for testing only. In the case of large classes, use a separate room with an assistant in charge. The students should get at least a certain minimum grade such as 80% on each module test. If the student gets less than 80% on a module test, the assistant should inform them individually that the module hasn't been completed. The assistant can, also, consult with the students (individually) to determine the part of the module they are having difficulty with. He can keep the records of the module test grades for each student assigned to him. The module grade should be an average of the grades whenever repeating is necessary. This discourages them from testing before they are ready. You will have to arrange some method of keeping track of which test a student takes since you will not want them to use the same test twice.

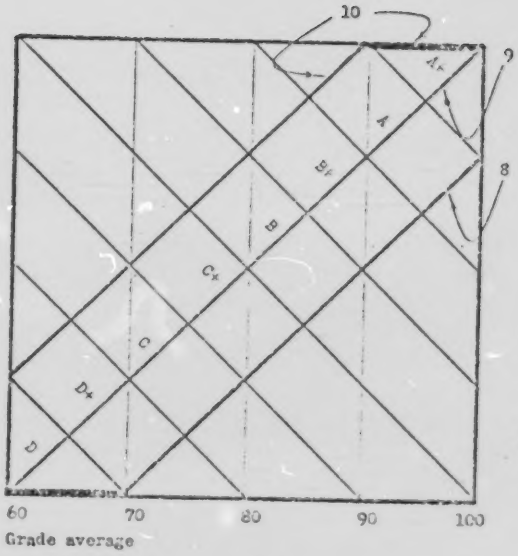
THE COMPUTER TERMINAL

If computer terminals are available in the class-lab room, they can be used to print out tests with randomly selected questions, grade them, indicate wrong answers, record grades and accumulate grade averages. The possibilities of what the computer can do depends on its type and the kind of terminal system it has. Details can be obtained through your data processing department.

GRADING THE COURSE

Several systems of grading the course can be employed. One method that works particularly well is described in figure 1. It is based on a combination of the test grade average and the number of satisfactorily completed units. Several variations

are possible. A change in the slope of the diagonal lines, for example, will give more emphasis to grade averages than quantity of work. You must decide on the minimum number of modules required of the course. One module with a laboratory experiment will take about one week to complete, assuming seven hours of class-lab time per week. Those modules without labs should require less time.



Notice that the center grading scale in figure 1 is the normal grading scale; 60-69 is the D range, 70-79 is the C range, etc. Students who complete one additional module are rewarded by being graded on the higher scale while those who complete one less module are graded on the lower scale.

CALENDAR

You will find that some students rush right through the course and finish it several weeks before the end of the term. These students like a self-paced course. Two students at Milford, for example; worked nearly every homework problem in every module. They pointed out numerous errors, most of which have been corrected. At the same time they were several weeks ahead of their classmates and finished the course about 4 weeks before the end of the term (11 week quarter). Most students plug away at a more average rate and finish up near the end of the quarter.

There are a few students who need to be prodded along, however. They start slowly, finishing the first module maybe after three weeks. Thus they are way behind all the rest of the way. Usually if the instructor asks if the student is about ready to test out of that module they

will say, "I'm going to take the test, tomorrow." Usually they do. Without your prodding, however, they might have procrastinated another week. Your record-keeping system should identify these students as soon as possible.

A course calendar may also be helpful in keeping the student aware of their own pace. Figure 2 shows a sample calendar giving the dates when each module should be started and finished. Students who have never taken an individualized course do have trouble in setting their own pace at the beginning.

SOLVING GENERAL MANAGEMENT PROBLEMS.

Avoid collisions between students who are wanting to use the same equipment for a lab experiment or to view the same film. They can begin the course with different modules. In this way, they are spread out right from the beginning. When this is desirable, because of a shortage of equipment in some modules, some students can begin with module M 2 (measurement). A different module, requiring no prerequisites, can be used as a starting point for some students. Module M 3 (vectors) and module M 6 (friction) are two examples. You will find that fewer pieces of equipment are needed, for a given experiment, than there would be if all students do the same one during the same week.

Normally, two students are required for each experiment so one may have to work on other learning activities until someone else is ready. Three can work together as partners, of course, but three should be the absolute maximum.

Another point. Avoid line-ups at the assistant's desk by having the students work on one of the other learning activities of the unit until the assistant is free.

GETTING THINGS READY FOR THE INDIVIDUALIZED PHYSICS COURSE

You will find that the class-lab room in a beehive of activity with students coming and going, doing experiments, testing, viewing films, seeking help with homework, etc. Considerable preparation is essential before the course can be taught this way. Those items that need to be prepared have been hinted at above and are repeated here in the form of a check list.

1. Arrange the class-lab room; lab benches for experimenting, tables or desk-chairs for testing, tables or desks for the assistant proctors.

2. Package the laboratory equipment for each module and locate it in the class lab room for easy student access. Label the packages or drawers.

3. Prepare copies of the tests for several modules before beginning the course. Others can be developed as the semester goes on. An answer key booklet can be put together simultaneously. A file cabinet in the class-lab room for the tests is almost essential.

4. Arrange with the Learning Resource Center for a place the students can view films or prepare a corner of the class-lab room if your department has its own film library.

5. Prepare a general orientation sheet and course outline for the students. The discussion in the "Instructions for Using Applied Physics Modules" needn't be repeated but students need to know the answers to the following questions:
    a) What modules make up the course?
    b) What module do I start with?
    c) How is the course graded?
    d) Can I test out of a module via "pretesting"?
    e) What is the general form of the tests and where do I sit to work on them?
    f) What is the minimum grade requirement for the module tests?
    g) Who are the assistants; what are their jobs; which proctor or tutor am I assigned to?
    h) Where is the lab equipment stored?
    i) Where do I go to view films, tapes, etc.

These questions and others could be answered orally the first time or two. The orientation sheet can be prepared later, after you've gained experience with self-paced courses but a course outline should be prepared for your first course.

SOME FINAL NOTES

The above suggestions are intended to be merely helpful hints on managing a self-paced physics course. Your special situation may demand modifications or altogether different methods of handling various aspects of the course. Even if room space, class size, type of lab equipment or other special conditions at your institution are at odds with some of the suggestions, you will find most of them helpful. Additional suggestions can be found in the references below. References 1, 6 and 7 are especially helpful.

Individualized courses usually receive favorable reactions from the students. They like going at their own speed, having fewer deadlines and being able to see the results of their efforts immediately. It adapts better to individual students needs caused by the diverse mathematical backgrounds found among technical students.

REFERENCES

1. Green, B. A., "Physics Teaching by the Keller Plan at MIT," American Journal of Physics, vol. 39, pp.764-775, July, 1971.
2. Cohen, Ahlen J., "Managing Self-Paced Physics Courses," The Physics Teacher, vol. 10, pp. 206-208, April, 1972
3. D'Arruda, Jose, "A Self-Paced Program of Instruction at a Two Year Institution," The Physics Teacher, vol. 11, pp.177-178, March, 1973.
4. Elliott, Walter E., "Experiences with Self-Paced General Physics Courses," The Journal of College Science Teaching, vol. 2, pp. 35-37, February, 1973
5. Swartz, Clifford E. and Ziptel, Christie, "Individualized Instruction in Introductory Physics," American Journal of Physics,vol. 40, pp. 1436-1442, October, 1972
6. Born, D.G., Instructor Manual for Development of a Personalized Instruction Course, Center to Improve Learning and Instruction, Universtiy of Utah, 1970 ($6.25).
7. Born, D.G., Proctor Manual, Center to Improve Learning and Instruction, University of Utah, 1970 ($2.25).

Instructor Notes

Module M 2 SIZING THINGS UP

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue.)

3 The lab equipment is located in drawer #4-1 in the class-lab room except for balance scales, weights and meter sticks. The balance scales and weights are on shelf #1E3 and the meter sticks are on the south wall of the stor:e room.

4. The students tend to ask the instructor how to read the vernier and micrometer calipers. Rather than show them, refer them to the lab information sheet in the APM booklet. Several examples are given.

5. The cautions on the lab instruction sheet are, in some cases, general rules for student behavior in the lab. These should be read to the student on the first day of class, before individualized study begins, (or assigned as special reading.)

6. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices, to estimate distances (metric), etc. Students should be reminded constantly to review the list of objectives.

INSTRUCTOR NOTES

Module M 3 THE NATURE OF VECTORS

1. The film loops and projectors are in the Learning Resource Center.

2. The tests, answer keys for test and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue.)

3. The lab equipment is located in drawer #4-4 in the class-lab room except for the slotted weights which are located on shelf #1 E 4.

4. The students tend to ask the instructor how to work problems, what formula to use, or how to proceed with an experiment. Rather than give detailed instructions or information, refer them to the text, information sheet, or lab instructions. Examples are given in most of the texts.

5. Of the objectives listed for most modules, there are basically three types. There are those that begin with the words:
   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, construct, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices, to construct vector diagrams; etc. Students should be reminded constantly to review the list of objectives.

6. Some of the textbooks also cover relative motion as a part of this subject. Since some did not, it was omitted from this module. If you wish to include it, you will have to assign it orally.

PREREQUISITES

Module M 2 Sizing Things Up

INSTRUCTOR NOTES

Module M 4 STATIC EQUILIBRIUM

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue.)

3. The lab equipment is located in drawer #4-5 in the class-lab room except for balance scales and meter sticks. The balance scales and the meter sticks are on the south wall of the store room.

4. Some students tend to ask the instructor how to calculate the unknown in the experiment. Rather than show them, refer them to the textbook or information sheets in this module. Several examples are given.

5. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

6. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

7. Modules M 2 and M 3 are prerequisite for this module.

INSTRUCTOR NOTES

Module M 5 MOVIN' ON (Motion)

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests, and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue.)

3. The lab equipment is located in the lab room and should be set up on tables in that room. The meter sticks are on the south wall of the store room.

4. The students tend to ask the instructor how to solve homework problems or lab problems. Rather than show them, refer them to the text or information sheet in the APM booklet. Several examples are given.

5. The cautions on the lab instruction sheet are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

6. Caution the students to use extreme care when using the Basic Spark Source in the experiment. They should not be allowed to start the experiment without reading the entire Lab Instruction Sheets first.

7. Remind students to review the objectives before taking the test.

8. Module M 2 is prerequisite for this module.

INSTRUCTOR NOTES

Module M 6 FRICTION

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests, and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue.)

3. The lab equipment is located in drawer #4-2 in the main class-lab room. Meter sticks, balance scales, etc. are in the storage room.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

5. The automotive and diesel versions of this module are written so that trigonometry is not a prerequisite. Thus, problems on an incline are excluded (see objectives). Note that the instruction sheets, lab experiments, test, as well as homework problems, are different than the other versions. The tests for the automotive-diesel programs are numbered with a letter T on them (Transportation department).

6. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using available references. Refer them to the textbook or the instructions included in this module.

7. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

8. Modules M 2 and M 3 are prerequisite for this module except for the automotive and diesel versions.

INSTRUCTOR NOTES

Module M 7 THE LAWS OF MOTION

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests, and lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue.)

3. The lab equipment for experiment I is located in the small lab, and for experiment II, in drawer #3-6 in the main class-lab room. Timers, meter sticks, balance scales, etc. are in the storage room.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

5. The more specific cautions for experiment I are to help prevent accidents (shock and burns from the Basic Spark Source) and to prevent damage to expensive as well as delicate lab equipment. Extra oral instructions should be given so the student will observe all the safety precautions.

6. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using available references. Refer them to the text book or the instructions included in this module.

7. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

8. Modules M 2 and M 5, are prerequisite for this module.

INSTRUCTOR NOTES

Module M 8 ENERGY & POWER

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue.)

3. The lab equipment is located in drawer #1-5 in the main class-lab room. Slotted weights are in the storage room.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

5. The more specific cautions for experiment I are to help prevent accidents and to prevent damage to delicate lab equipment. Extra, oral instructions should be given so the student will observe all precautions.

6. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using available references. Refer them to the textbook or the instructions included in this module.

7. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handilng lab equipment. Students should be reminded constantly to review the list of objectives.

8. Module M 7 is prerequisite for this module.

INSTRUCTOR NOTES

Module M 9 SIMPLE MACHINES

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests, and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue.)

3. The lab equipment is located in drawer #4-3 in the main class-lab room. Calipers, rules, weights, spring scales, etc., are in the storage room.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

5. The more specific cautions are to help prevent accidents, and to prevent damage to expensive as well as delicate lab equipment. Extra, oral instructions should be given so the student will observe all safety precautions.

6. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments, and for other help without using available references. Refer them to the textbook or the instructions included in this module.

7. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

8. Module M 8 is prerequisite for this module.

INSTRUCTOR NOTES

Module M 10 UNIFORM CIRCULAR MOTION

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue)

3. The lab equipment is located in drawer #1-4 in the main class-lab room. Timers, meter sticks, balance scales, etc. are in the storage room.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

5. The more specific cautions for experiment I are to help prevent accidents and to prevent damage to expensive as well as delicate lab equipment. Extra, oral instructions should be given so the student will observe all the safety precautions.

6. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using available references. Refer them to the textbook or the instructions included in this module.

7. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

8. Modules M 8 and M 9 are prerequisite for this module.

9. Students who work with motors and generators should complete the report. (See learning activities.) The best reference for this subject is Electric Motor Repair, Robert Rosenberg, Holt-Rinehart-Winston, 1960. Pages 166-168 and 178-183. This book is now "out of print" but copies are available in the Electrical Technology library.

INSTRUCTOR NOTES

Module M 11 POWER TRANSMISSION

1. The filmstrips and projectors are in the Learning Resource Center.

2. The test, answer keys for tests, and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue.)

3. The lab equipment is located in the storage room. Tachometers, spring scales, vernier calipers, etc. are on the storage room shelves.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horse-play before it gets out of hand.

5. The more specific cautions for experiment I are to help prevent accidents and to prevent damage to expensive, as well as, delicate lab equipment. Extra, oral instructions should be given so the student will observe all the safety precautions.

6. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using available references. Refer them to the textbook or the instructions included in this module.

7. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

8. Modules M 8, M 9, and M 10, are prerequisite for this module.

9. All automotive, diesel, electrical, and electromechanical students should perform the laboratory experiment since they work with power measurement. This is not meant to imply that students in other programs should be excused.

10. Arrange a guided tour of the dynamometers in use on the Milford Campus. (See Learning Activity #VII.) Each class should be given this tour separately. More than one tour may be necessary for large classes. About ten or twelve students is the most an instructor can handle in one group. Some of the shops are too noisy to handle more. The tour takes about 30-40 minutes.

11. Recommend, orally, the outside reading (Learning Activity # III.). Modern design and applications of flywheels is quite surprising.

INSTRUCTOR NOTES

Module M 12 SIMPLE HARMONIC MOTION

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue).

3. The lab equipment is located in drawer #1-5 in the main class-lab room. Timers, meter sticks, balance scales, etc. are in the storage room.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

5. The more specific cautions for the experiments are to help prevent accidents and to prevent damage to expensive as well as delicate lab equipment. Extra, oral instructions should be given so the student will observe all the safety precautions.

6. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using available references. Refer them to the textbook or the instructions included in this module.

7. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

8. Module M 10 is prerequisite for this module. Module M 8 would also be helpful.

9. There are two experiments in this module and one optional experiment:
   1. Mass on a spring
   2. Pendulum
   3. Inertial mass balance (optional)

   The third experiment is listed as optional but all instructions are included. It was a part of module M 7 (Laws of Motion). If M 7 is not a part of this course you may wish to require it as a part of this module.

INSTRUCTOR NOTES

Module T 1 TEMPERATURE AND THERMAL EXPANSION

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue).

3. The experiment in this module is on thermal expansion and the results are fairly accurate. Precision equipment is used.

4. The lab equipment is located in drawer #6-2 in the main class-lab room. Hoses and steam generators are in drawer 6-1.

5. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

6. The more specific cautions for experiment I are to help prevent accidents and to prevent damage to delicate lab equipment. Extra, oral instructions should be given so the student will observe all precautions. Hot water and steam is used in this experiment. Caution the student to use care with thermometers.

7. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using available references. Refer them to the textbook or the instructions included in this module.

8. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:
   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

9. There are no specific prerequisite for this module but the student should be familiar with the metric system.

INSTRUCTOR NOTES

Module T 3 TRANSFER OF HEAT

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue).

3. Some students tend to ask the instructor how to calculate the unknown in homework problems and for other help without using available references. Refer them to the textbook or the instructions included in this module.

4. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

5. Modules T 1 and T 2 are prerequisite for this module.

6. There are no experiments written up for this module. If you wish to include one, equipment for a continuous flow calorimeter (Such as Sargent Welch #1686) could be used. This acts similar to a heat exchanger or cooler. You could test the apparatus to see if wrapping it with aluminum foil has any effect on the transfer of heat.

INSTRUCTOR NOTES

Module P 1 MECHANICAL PROPERTIES OF MATTER

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue.)

3. The lab for this module is the same as the one for Module M8 If the students have performed this experment before, they do not need to repeat it. The lab instructions are included in the student manual.

4. The lab equipment is located in drawer #1-5 in the main class-lab room. Slotted weights are in the storage room.

5. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

6. The more specific cautions for experiment I are to help prevent accidents and to prevent damage to delicate lab equipment. Extra, oral instructions should be given so the student will observe all precautions.

7. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using available references. Refer them to the textbook or the instructions included in this module.

8. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

9. Although this module stands alone and has no specific prerequisites, some knowledge of the metric system is necessary.

INSTRUCTOR NOTES

Module # 2 FLUIDS I (STATICS)

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue).

3. The lab equipment is located in drawer #5-4 and 5-6. Lab stands and bases are in drawer #1-2. Beakers, meter sticks and balance scales are in the storage room.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

5. The more specific cautions for the experiments are to help prevent accidents and to prevent damage to expensive as well as delicate lab equipment. Extra, oral instructions should be given so the student will observe all the safety precautions.

6. Some students tend to ask the instructor how to calculate the unknown in Homework problems or in the experiments and for other help without using available references. Refer them to the textbook or the instructions included in this module.

7. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   (a) State, describe, list, define, etc.
   (b) Convert, solve, derive, round off, etc.
   (c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

8. There are no prerequisites for this module but the student should be familar with the metric system.

INSTRUCTOR NOTES

Module P 3 FLUIDS II (DYNAMICS)

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue.)

3. The lab equipment for experiment I is located in #5.5 in the main class-lab room. Timers, beakers, hoses etc. are in the storage room. The Digiac trainer has been moved from room to room, recently during remodeling. You may have to search for it because it doesn't have a permanent home.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

5. The more specific cautions for experiment I are to help prevent accidents (glassware is always subject to breakage) and to prevent damage to expensive as well as delicate lab equipment. Extra, oral instructions should be given so the student will observe all the safety precautions. Be sure the students have read the instructions before starting the experiment.

6. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using the available references. Refer them to the textbook or the instructions included in this module.

7. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

8. Module P 2 is a prerequisite for this module.

INSTRUCTOR NOTES

Module W 1 WAVE MOTION

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue).

3. The lab equipment is located in drawer #1-6 in the main class-lab room.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

5. The more specific cautions for experiment I are to help prevent accidents and to prevent damage to delicate lab equipment. Extra, oral instructions should be given so the student will observe all precautions.

6. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using available references. Refer them to the textbook or the instructions included in this module.

7. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   (a) State, describe, list, define, etc.
   (b) Convert, solve, derive, round off, etc.
   (c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

8. Module M 12 Simple Harmonic Motion is prerequisite for this module.

9. The metric system is used exclusively in this module and all modules prefixed with the letter W.

INSTRUCTOR NOTES

Module W 2 INTERFERENCE OF WAVES

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue).

3. The lab equipment for experiment I is in the storage room. Tuning forks and the equipment for experiment II is in drawer #2-1 in the main classroom. Vacuum pumps and hand pumps are in the storage room.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

5. The more specific cautions for the experiments are to help prevent accidents and to prevent damage to expensive as well as delicate lab equipment. Extra, oral instructions should be given so the student will observe all the safety precautions.

6. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using available references. Refer them to the textbook or the instructions included in this module.

7. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:

   (a) State, describe, list, define, etc.
   (b) Convert, solve, derive, round off, etc.
   (c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

8. Module W 1 is prerequisite for this module.

9. The metric system is used exclusively in all modules with the prefix W.

INSTRUCTOR NOTES

Module W 3 SOUND SOURCES

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue).

3. The experiment in this module measures the speed of sound with a resonance tube and the results are fairly accurate. Precision equipment is used.

4. The lab equipment is located in the corner of the storeroom. Tuning forks are in drawer 3 - 5 in the classroom.

5. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horseplay before it gets out of hand.

6. The more specific cautions for experiment I are to help prevent accidents and to prevent damage to delicate lab equipment. Extra, oral instructions shoud be given so the student will observe all precautions. Water is used in this experiment. Caution the student to use care with thermometers.

7. Some students tend to ask the instructor how to calculate the unknown in homework problems or in the experiments and for other help without using available references. Refer them to the textbook or the instructions included in this module.

8. Of the objectives listed for this module, there are basically three types. There are those that begin with the words:
   a) State, describe, list, define, etc.
   b) Convert, solve, derive, round off, etc.
   c) Estimate, use, etc.

   The test, therefore, consists of questions of three general types. The first involves memory work; students have to state or answer questions about a definition, law, etc. The second type requires that they be able to solve problems. The third involves their ability to use certain measuring devices and handling lab equipment. Students should be reminded constantly to review the list of objectives.

9. Module W 1 is prerequisite for this module.

INSTRUCTOR NOTES

Module W 4 ILLUMINATION

1. The filmstrips and projectors are in the Learning Resource Center.

2. The tests, answer keys for tests and the lab data sheets are on separate loose paper and are located in file drawer #1. (Tests are in pink; data sheets in blue).

3. The lab equipment for the experiments are located in the storeroom. You will have to set up the second experiment in a dark room.

4. The cautions on the lab instruction sheets are, in some cases, general rules for student behavior in the lab. Stop horesplay before it gets out of hand.

5. The more specific cautions in the procedure section are to help prevent damage to expensive as well as delicate lab equipment. Extra, oral instructions should be given so the student will observe all the safety precautions. Be sure the students have read the instructions before starting the experiment.

6. There are no prerequesites for this module although module M 8 (Energy and Power) would be helpful. The metric system is used exclusively in this module.

7. If you have a light meter (foot-candle meter) available, you could send the student on a field trip to measure the illumination in the classrooms, labs, hallways etc. Make up a data sheet for him to fill out. Have the student convert from foot-candles to luxes. This would be helpful, especially, to electrical technology students.

APPENDIX I

MODULE COVERAGE

M 2	SIZING THINGS UP: Measuring systems; fundamental and derived units; conversion of units; the metric system; precision measurement and accuracy in measurement and computations.
M 3	THE NATURE OF VECTORS: Vectors; composition of vectors; resolution of vectors; displacement and equilibrium of concurrent forces.
M 4	STATIC EQUILIBRIUM: Moment of force; center of gravity; types of equilibrium; equilibrium (parallel forces) and equilibrium (non-parallel, non-concurrent forces).
M 5	MOVIN' ON (MOTION): Displacement, velocity and acceleration; constant velocity; accelerated motion; gravity and vertical motion.
M 6	FRICTION: The nature of friction; coefficient of friction; kinetic and static friction; angle of repose; rolling friction and lubrication.
M 7	THE LAWS OF MOTION: Force causes motion changes; inertia; Newton's three laws; mass and weight.
M 8	ENERGY AND POWER: Work, energy and power; classification of energy; Units; energy transformation: the work equation and law of conservation of energy.
M 9	SIMPLE MACHINES: Mechanical advantages; efficiency; lever, incline plane and hydraulic jack; modifications of basic machines and compound machines.
M 10	UNIFORM CIRCULAR MOTION: Angular measurement; angular velocity; uniform circular motion; centripetal and centrifugal forces.
M 11	POWER TRANSMISSION: Rotational dynamics; gears and pulleys; torque and power transmission and torque and power measurements.
M 12	SIMPLE HARMONIC MOTION: Hooke's law; displacement and amplitude; period and frequency; SHM; velocity, acceleration, force and energy in SHM.
P 1	MECHANICAL PROPERTIES OF MATTER: Density; elasticity; stress and strain; factor of safety; malleability and ductility.
P 2	FLUIDS I (STATICS): Pressure and vacuum; buoyancy and specific gravity; Pascal's principle and the atmosphere.
P 3	FLUIDS II (DYNAMICS): Rate of low; velocity of flow; Bernoulli's principle viscosity; hydraulic valves and circuits.
P 4	STRUCTURE OF MATTER: Sub-atomic particles; structure of the atom; periodic chart; molecules; kinetic theory of gases and properties of matter.

T 1 TEMPERATURE AND THERMAL EXPANSION: Temperature; linear expansion (solids); volume expansion (solids, liquids and gases).

T 2 HEAT AND CHANGE OF STATE: Heat units; heating value of fuels; specific heat; latent heat and change of state.

T 3 TRANSFER OF HEAT: Conditions for heat transfer; conduction; convection; radiation; law of cooling.

W 1 WAVE MOTION: Waves; the wave equation; velocity, wavelength and frequency; velocity of sound and light; reflection and re raction.

W 2 INTERFERENCE OF WAVES: Principle of superposition; constructive and destructive interference; standing waves; beats; interference of light; voltage waveforms.

W 3 SOUND SOURCES: Strings and pipes; overtones and harmonics; resonance; sound level (db); Doppler effect.

W 4 ILLUMINATION: Solid angle; luminous flux; luminous intensity; illumination; inverse square law; luminous efficiency.

W 5 ELECTROMAGNETIC WAVES AND POLARIZATION: Electric and magnetic fields; em waves; electromagnetic spectrum; production and reception of em waves; photons; polarization.

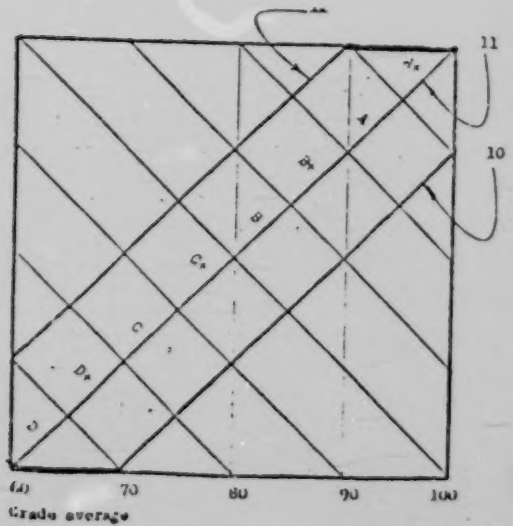
Applied Physics Module

SOUTHEAST COMMUNITY COLLEGE—Milford Campus Milford, Nebr. 68405

COURSE OUTLINE: ELECTRONIC ENGINEERING PHYSICS I (5220405)

There are twelve modules that make up this course. A minimum of ten modules must be completed.

Module	Module title	Requirements (Hand in)
M 2	Sizing Things Up	Lab A,B & D; problems 22, 26, 29
M 3	The Nature of Vectors	Lab; problems 11, 16, 17
M 4	Static Equilibrium	Lab; problems 10, 11
M 5	Movin' On (Motion)	Lab A; problems 7, 8, 10, 14
M 6	Friction	Lab; problems 6, 9, 11
M 7	Laws of Motion	Lab 1 & 2, problems 8, 16, 17
M 8	Energy and Power	Lab; problems 10, 12, 14, 15
M 9	Simple Machines	Lab 4; problems 9, 10, 11, 12
M 10	Uniform Circular Motion	Lab; problems 8, 10, 18, 20
M 11	Power Transmission	Lab; problems 8, 9, 10, 16
P 1	Mechanical Properties of Matter	Problems 6, 7, 14, 15
P 4	Molecular Properties of Matter	Problems 4, 5, 7, 10, 13



GRADING SYSTEM

This system bases final grades on both quality and quantity of work. If you have an 89 test average with 11 completed modules for example, the teacher finds your grade by moving vertically upward at the 89 mark until it intersects a heavy sloping line marked number 11.

The intersection lies in the B+ range. This is your grade.

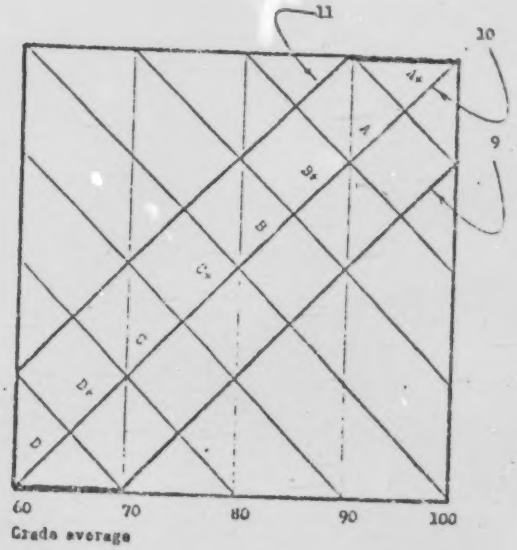
Applied Physics Module

SOUTHEAST COMMUNITY COLLEGE—Milford Campus Milford, Nebr. 68405

COURSE OUTLINE: ELECTRONIC ENGINEERING PHYSICS II (5220505)

There are eleven modules that make up this course. A minimum of nine modules must be completed.

Module	Module title	Requirements
P 2	Fluids I (Statics)	Lab I; problems 8, 11, 13, 15
P 3	Fluids II (Dynamics)	Lab II, problems 13, 14, 15
T 1	Temperature and Thermal Expansion	Lab; problems 14, 17, 22, 23, 28, 30
T 2	Heat and Change of State	Lab I; problems 13, 17, 19, 21, 24
T 3	Heat Transfer	Report; problems 7, 8, 21, 25
M 12	Simple Harmonic Motion	Labs A & B; problems 8, 10, 15, 19
W 1	Wave Motion	Labs A & B; problems 13, 18, 20, 24
W 2	Superposition and Interference	Labs A & B; problems 7, 8, 17, 25
W 3	Sound Sources	Lab; problems 11, 12, 16, 21, 22
W 5	Electromagnetic Waves Polarization	Problems 5, 8, 9, 10, 12, 17, 18, 19
W 4	Illumination	Labs I & II; problems 8, 10, 12, 13, 19



GRADING SYSTEM

This system bases final grades on both quality and quantity of work. If you have an 89 test average with 11 completed modules for example, the teacher finds your grade by moving vertically upward at the 89 mark until it intersects a heavy sloping line marked number 10.

The intersection lies in the B+ range. This is your grade.

A P P L I E D
P H Y S I C S
M O D U L E

SOUTHEAST COMMUNITY COLLEGE -Milford Campus Milford, Nebr. 68405

INSTRUCTIONS FOR USING APPLIED PHYSICS MODULES

COURSES: EE404 Physics I (Electronic Engineering Technology)
ES404 Physics I (Electronic Service Technology)
EL404 Physics I (Electrical Technology)
EM205 Physics for Manufacturing (Electromechanical)

PURPOSE: These instructions have been prepared to assist you in using Applied Physics Modules. You will proceed on your own by completing one module at a time and advancing to the next one at your own pace. Your instructor will require that a certain minimum number of modules be satisfactorily completed by the end of the term. Your course grade will depend on the number that you complete. Details about the grading system and directions about the management of the course are given on the following pages.

Producer: Gene Waring

Date Produced: February 1977

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APPLIED PHYSICS MODULES

Each module is self-contained covering one topic in physics and material related to that topic. Almost all modules contain technological applications in your rield that are presented either as a laboratory experiment or in the form of applied homework problems.

COMPONENTS OF AN APPLIED PHYSICS MODULE

Each module contains several components. These components are:

1. Module contents (cover page)
2. Purpose (cover page)
3. Objectives
4. Learning Activities
5. Self-Evaluation
6. Test

Each component has a specific purpose. The discussion below gives you instructions on how to use each one to help you to complete the module satisfactorily.

MODULE CONTENTS: The information in the module contents gives you a brief overview of the subject matter of the module. It is similar to the subheadings of a chapter in the text. Always begin the study of a new module by reading this list on the front page of the module instructions.

PURPOSE: The purpose is a brief statement that tells you why the subject matter of the module is important. Your second step in studying a module is to read the statement of purpose on the front page.

OBJECTIVES: The objectives of a module are the most fundamental component of all. They tell you, exactly, what you must be able to do in order to complete the module satisfactorily. Read this list third.

Some objectives tell you that you must be able to define, state, list, describe, show, etc. These are the simpler objectives. The definitions, lists, laws, principles, etc. they refer to can be found in the reading matter of the text or the Information Sheets. You learn to do these by memorization. More complex objectives tell you to solve, evaluate, calculate, etc. You learn to do these by practicing, studying examples, solving problems or performing laboratory experiments.

Refer to the list of objectives as you study each part of the module. Keep it handy. Read it before starting the learning activities. Reread it as you study. Use it as a check list before you take the module test. Remember: the module test is based on the objectives to make sure that you have achieved them.

LEARNING ACTIVITIES: Learning activities are listed for each module. They will help you learn to do the things itemized in the objectives. They are in the form of an assignment sheet and are optional. Lab experiments, however, are required. Each of the activities that are common to most modules is discussed below.

I. Reading: Each module has the chapter number, section numbers and page numbers of the reading activity for several textbooks (including yours) given under this heading. As you read, keep the list of objectives for the unit open. Make a list (on separate paper) of the laws, definitions, principles, etc., referred to by the simpler objectives. They will usually be found in the text in the order they are listed. The list you make will be very useful as an aid in memorizing them. An Information Sheet is included in most modules. These pages are printed on green paper. In most cases, they cover subject matter that is presented only briefly or not at all in some of the textbooks. Be sure to read the Information Sheet

II. Listening/Viewing: Most modules include one or more single-concept film loops, filmstrips with cassette tapes or other non-print materials. Information about the film loops (in the form of notes) are either printed on the box or on a sheet, packaged with the film. Read these notes before viewing.

Your instructor will show you how to use the equipment for viewing the films and listening to the tapes, etc. The films, tapes, etc. are located in the Learning Resource Center. You may view them during or after physics class. (After school if you wish). No more than three people should use any one piece of equipment at one time. Your instructor will give you more information about using the LRC for this purpose. The LRC is open Monday through Thursday from 7:30 AM to 10 PM and on Friday from 7:30 AM to 5 PM.

III. Performing Laboratory Experiments: Most modules require the completion of one or more laboratory experiments. A full explanation of the procedure is included in the student instruction booklet near the back (printed on yellow paper). Do not start the experiment until you have read the entire lab instructions. Pay particular attention to and observe all CAUTIONS.

The equipment for a given experiment is usually packaged so you can pick it up, take it to a lab bench, perform the experiment, and return it to storage. Obtain a data sheet from the instructor. The laboratory experiments are required. Your completed data sheet must be turned in before you may take the test for the module.

IV. Solving Problems: A set of applied problems is included for each module in the student instructions. They are printed on ivory paper. An answer key is on the final page with answers to all problems. There are numerous solved problems in your text and in the Information Sheets. Refer to them as examples. Follow the method used in solving the examples to find solutions to your problems. Keep in mind what you must learn to do; refer

to the objectives. Don't just manipulate the numbers around to arrive at an answer. Learn the method and apply it to your work.

Solve as many of the problems as you feel are necessary to learn the method. There are usually more problems included than you will want to use. Pick those that interest you most but choose a variety according to the objectives of the module. The problems usually range from easy to difficult. Most of them are applied to your technology.

V. Others: Some modules have other learning activities such as guided tours, extra reading and reports. Your instructor will inform you which ones are required or optional. Only a few modules have these learning activities.

SELF-EVALUATION TEST: A self-evaluation test is included in each module instruction booklet (printed on pink paper). An answer key accompanies the test. If you take this test under the same restrictions as required on the module test it will serve as an indication of your prepardness for finishing the module. If you miss any of the questions, directions are given for finding the correct answer and the answers to similar questions. DO NOT WRITE IN THE INSTRUCTION BOOKLET.

You may use the self-evaluation test at any time. For example, you can use it as a pre-test. This will serve as an indication of what learning activities to work on. Your instructor will make suggestions, if you wish. You could use the test as a sample test just before taking the module test which is similar. Compare the self-evaluation test with the objectives. You should be aware that test questions are similar but not identical.

TEST: The module test will measure what you have learned. It is given to determine if you can do the things listed in the objectives. After doing some of the learning activities and evaluating yourself with the self-evaluation test, review the list of objectives as a final check before taking the test. The test must be finished in one sitting; don't start it if there isn't time to finish.

When you are ready to take the module test, ask the instructor for a copy. NOTE: there are five or more versions of the test for each module. The instructor may give you any one of these.

An area in the class-lab room is reserved for testing. Please sit in the front row tables. If scratch paper is furnished, turn it in with the test when you finish. Ususally, however, there is plenty of room on the test itself for calculations. Return the completed test to the instructor. It will be graded and returned to you at once. Review the problems and questions you missed. If the instructor is busy with other students, he will call you back when it is checked.

If you did not achieve the stated grade minimum (80% in most cases), you will have to repeat the module test. Determine, with the instructors help, the subjects you are having

difficulty with. Solve additional problems involving those subjects. Reread the objectives and text before repeating the test. When you have completed the module satisfactorily, proceed to the next module.

A FINAL WORD

You will profit most from individualized study if you proceed from one part of the module to another, without long delays in between. Read the objectives first. Work the problems soon after reading the text. View the films and perform the laboratory experiment next. The films and the experiment will be more meaningful if you do the activities in that order. Remember you are studying individually. Begin the next unit immediately after finishing the previous one. Although there are no deadlines to meet on specific modules, there is a minimum number of modules that must completed by the end of the term. Keep going.

NAME_____

Test A

Module W 5 ELECTROMAGNETIC WAVES AND POLARIZATION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 8 - 10, show your work and circle your final answer. Be sure to include your name in the space provided.

T - F 1. Red light has a higher frequency than blue light.

T - F 2. Polarization only occurs in transverse waves.

T - F 3. Electromagnetic waves can travel through empty space.

T - F 4. When the angle of incidence is such that the angle between the reflected and refracted rays is 180^{o}, the reflected beam is plane polarized.

T - F 5. A magnetic field is directed out of the paper. The path of an electron traveling upward (towards top of paper) will curve to the right.

6. The direction of the magnetic field strength (B) in an em wave transmitted by a vertical antenna is:

   a) parallel to propagation direction
   b) perpendicular to E
   c) parallel to E
   d) vertical

7. KLIN-FM radio (Lincoln, NE) broadcasts on a frequency of 107.3 MHz. If this station uses a dipole antenna with current nodes at each end and an antinode at the center, what is its length? The speed of the current wave is 2.1×10^{8} m/s.

   a) 1.96 m
   b) 9.8 m
   c) 0.98 m
   d) 0.49 m

8. What is the index of refraction of diamond if its polarizing angle is 67.5^{o}?

OVER

9. How much energy does an x-ray photon possess if its wavelength is 10^{-10} m ?

10. What is the magnitude and direction of the force on an electron between parallel plates if the electric field strength is 275 N/C^2 in an upward direction?

NAME_____

TEST B

Module W 5 ELECTROMAGNETIC WAVES AND POLARIZATION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 8 - 10, show your work and circle your final answer. Be sure to include your name in the space provided.

T - F 1. Blue light has a lower frequency than red light.

T - F 2. Longitudinal waves cannot be polarized.

T - F 3. Electromagnetic waves transport electric charge.

T - F 4. When the angle of incidence (i) is such that the angle of refraction (r) is given by r = 90 - i, the reflected part of the beam will be plane polarized.

T - F 5. An electric field is directed downward (towards bottom of paper). The path of an electron traveling leftward will curve downward.

6. The direction of the electric field strength (E) in an em wave transmitted by a vertical antenna is:

a) perpendicular to propagation direction
b) horizontal
c) parallel to B
d) Random

7. KWBE-FM radio (Beatrice, NE) broadcasts on a frequency of 92.9 MHz. If this station uses a dipole antenna with current nodes at each end and an antinode at the center, what is its length? The speed of the current wave is 2.1×10^8 m/s.

a) 5.7 m
b) 0.57 m
c) 2.26 m
d) 1.13 m

8. What is the polarizing angle of quartz if its index of refraction is 1.46?

OVER

9. An infra-red photon possesses 1.33×10^{-19} J of energy. What is its wavelength?

10. An electron enters a magnetic field with a strength of 0.0295 T in an eastward direction. If the force on the electron is 1.725×10^{-14} N in a northerly direction, what is the magnitude and direction of its velocity?

NAME_____

TEST C

Module W 5 ELECTROMAGNETIC WAVES AND POLARIZATION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 8 - 10, show your work and circle your final answer. Be sure to include your name in the space provided.

T - F 1. Red light has a lower frequency than blue light.

T - F 2. Sound waves are the only longitudinal waves that can be polarized.

T - F 3. Electromagnetic waves, like other waves, transport energy.

T - F 4. When the angle of incidence (i) is such that the angle of reflection (r) is given by r = 90 - i, the reflected part of the beam will be plane polarized.

T - F 5. A magnetic field is directed toward the left. An electron traveling rightward will pass through the field undeflected.

6. The direction of the magnetic field strength (B) in an em wave transmitted by a vertical antenna is:

a) perpendicular to propagation direction
b) vertical
c) parallel to E
d) random

7. KFMQ-FM radio (Lincoln, NE) uses a 1.102 m dipole antenna with current nodes at each end and an antinode at the center, what is the broadcast frequency of this station? The speed of the current wave is 2.1×10^8 m/s

a) 190.6 MHz
b) 95.3 MHz
c) 95.3 kHz
d) 47.6 MHz

8. What is the index of refraction of ice if its polarizing angle is 52.6°?

OVER

9. How much energy does an ultra-violet photon posses if its wavelength is 2×10^{-8} m ?

10. An electron between parallel plates has a force of 5.2×10^{-16} N on it in a westerly direction. What is the electric field strength (magnitude and direction)?

NAME_____

TEST D

Module W 5 ELECTROMAGNETIC WAVES AND POLARIZATION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 8 - 10, show your work and circle your final answer. Be sure to include your name in the space provided.

T - F 1. Red light has a longer wavelength than blue light.

T - F 2. Sound waves cannot be polarized.

T - F 3. Sound waves are electromagnetic waves.

T - F 4. When the angle of incidence is such that the angle between the incident ray and the reflected ray is 90°, the reflected part of the beam will be plane polarized.

T - F 5. An electron traveling out of the paper experiences a force towards the left. The magnetic field must be directed toward the top of the paper.

6. The direction of the magnetic field strength (B) in an em wave transmitted by a vertical antenna is:

   a) vertical
   b) parallel to E
   c) parallel to the antenna
   d) none of these

7. KOOO-FM radio (Omaha, NE) uses a 1.005 m dipole antenna with current nodes at each end and an antinode at the center, what is the broadcast frequency of this station? The speed of the current wave is 2.0×10^8 m/s.

   a) 209 kHz
   b) 104.5 kHz
   c) 52.3 MHz
   d) 104.5 MHz

8. What is the polarizing angle of glycerin if its index of refraction is 1.48?

OVER

9. A gamma ray photon possesses 2×10^{-9} J of energy. What is its wavelength?

10. An electron traveling south at 5.50×10^{6} m/s enters a magnetic field with a strength of 0.00595 T in a vertically upward direction. What is the magnitude and direction of the force on the electron?

NAME_____

TEST E

Module W 5 ELECTROMAGNETIC WAVES AND POLARIZATION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 8 - 10, show your work and circle your final answer. Be sure to include your name in the space provided.

T - F 1. Red light has a shorter wavelength than blue light.

T - F 2. Polarization can occur in both longitudinal and transverse waves.

T - F 3. Radar waves, infrared rays, x-rays, radio waves and light rays are all electromagnetic waves.

T - F 4. When the sum of the angle of reflection and the angle of refraction is 90°, the reflected beam is plane polarized.

T - F 5. An electric field is directed towards the right, the path of an electron traveling upward (towards top of paper) will curve out of the paper.

6. The direction of the electric field strength (E) in an em wave transmitted by a vertical antenna is:

   a) perpendicular to B
   b) vertical
   c) parallel to the antenna
   d) all of these

7. KFAB-FM radio (Omaha, NE) broadcasts on a frequency of 99.9 MHz. If this station uses a dipole antenna with current nodes at each end and an antinode at the center, what is its length? The speed of the current wave is 2.1×10^8 m/s.

   a) 0.525 m
   b) 1.051 m
   c) 2.102 m
   d) 4.204 m

8. What is the index of refraction of calcite if its polarizing angle is 58.9°?

OVER

9. How much energy does a gamma ray photon possess if its wavelength is 10^{-12} m ?

10. What is the magnitude and direction of the force on an electron between parallel plates if the electric field strength is 875 N/C in a downward direction?

TEST ANSWER KEYS

Module W 5 ELECTROMAGNETIC WAVES AND POLARIZATION

PROBLEM	A	B	C	D	E
1	F	F	T	T	F
2	T	T	F	T	F
3	T	F	T	F	T
4	F	T	F	F	T
5	F	T	T	F	F
6	b	a	a	d	d
7	c	d	b	d	b
8	2.41	55.6^{o}	1.31	56.0^{o}	1.66
9.	1.99×10^{-15} J	14950 Å	9.95×10^{-18} J	9.95×10^{-17} m	1.99×10^{-13} J
10.	4.41×10^{-17} N upward	3.65×10^{6} m/s into paper	3.25×10^{3} N/C westward	5.24×10^{-15} N eastward	1.402×10^{-16} N downward

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

DATA SHEET

Module M 8

ENERGY & POWER

Steps 1 - 6

Mass on hanger (g)	Weight on hanger (dyne)	Pointer position (cm)	Difference in successive readings (cm)
0			
50			
100			
150			
200			
250			
200			
150			
100			
50			
0			
			average

Step 10

Step 8

Step 14 _____ dynes

Step 11 _____ dynes/cm

Step 15 _____ ergs

Step 13 _____ erg

Step 16 _____ %

Steps 18-23

Position	Location	Elastic	Gravitational	Kinetic	Total energy
1					
2					
3					

Step 24 _____ % _____ %

Step 25

Steps 26 - 28

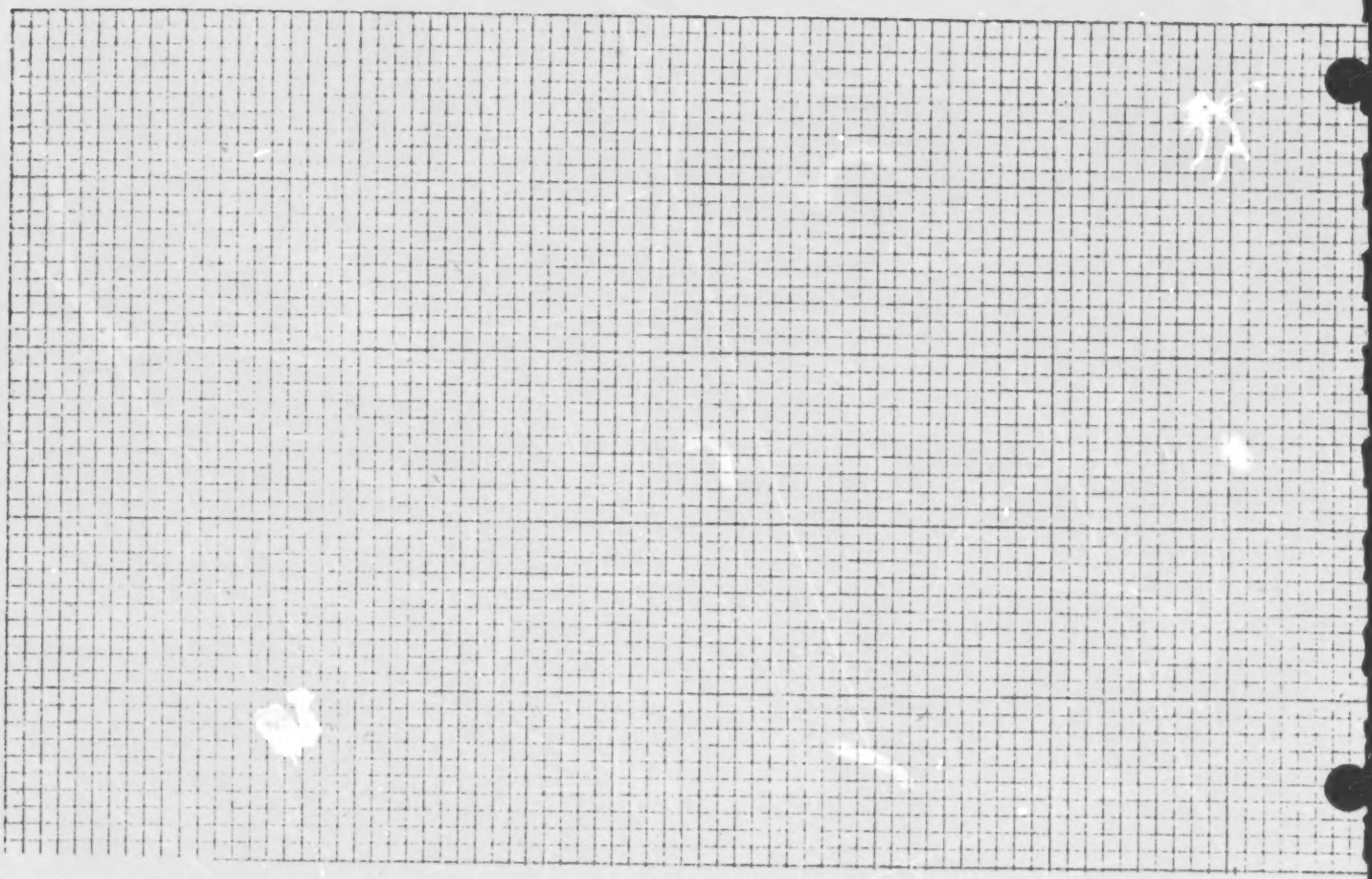
Mass on hanger (g)	Weight on hanger (dynes)	Pointer position (cm)	Difference in successive readings (cm)
0			
5			
10			
15			
20			
			average

Step 30 _____ dyne/cm

Step 31

Step 32

Steps 7 and Step 29



NAME_____

TEST A

Module M 8 ENERGY & POWER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Work will always be done on an object if an external force causes motion parallel to the direction of the force.

T - F 2. Not all moving objects posses kinetic energy.

T - F 3. One joule equals one foot-pound.

T - F 4. In lifting a TV set from the floor to a table, the work done is: The mass of the set times the height of the table.

T - F 5. Engines, motors, furnaces, and generators are devices that transform energy from one form to another.

6. The unit of energy expressed in fundamental cgs units is:

a) g·cm
b) ft·lb
c) $g \cdot s^2/cm^2$
d) $g\ cm^2/s^2$

7. A 64 N weight is lifted 20 m. The work done is:

a) 1280 J
b) 12 500 J
c) 12 800 erg
d) 1280 ft·lb

8. An 1800 kg automobile is traveling 60 km/h (16.67 m/s). What is its kinetic energy?

a) 2 450 000 ft·lb
b) 2 450 000 J
c) 250 000 J
d) 250 000 ft·lb

9. A force of 5.5 lb will stretch a stiff spring 0.25 in. The spring constant is:

a) 264 lb/ft
b) 22 lb/ft
c) 0.69 lb/in
d) 704 lb/in

10. What average force would be acting on a 1 oz bullet as it penetrates wood to a depth of 4 in? It speed just before impact is 1000 ft/s.

(OVER)

11. An elevator and its contents have a mass of 1500 kg. It moves 150 m to the top of a building in 120 s. What power is required?

NAME_____

TEST B

Module M 8 ENERGY & POWER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. If an object moves then work is being done on it.

T - F 2. Objects that are under tension (stretched), compression or torsion (twisted), possess elastic potential energy.

T - F 3. One joule equals one newton per meter.

T - F 4. If one newton of force stretches a spring 1.5 cm, then 3.5 N will stretch it 5.25 cm.

T - F 5. When work is done against friction, energy is transformed from one form to another.

6. The unit of energy expressed in fundamental British units is:

a) ft·lb
b) ft/lb
c) lb/ft
d) ft^2s^2/lb

7. A 64 kg mass is lifted 20 m. The work done is:

a) 1280 J
b) 12 500 J
c) 12 800 erg
d) 1280 ft lb

8. An automobile is traveling 60 km/h (16.67 m/s) and has a kinetic energy of 200 000 J. What is the mass of the automobile?

a) 24 000 kg
b) 111 kg
c) 14 100 N
d) 1440 kg

9. A 64 lb weight is lifted 20 ft. Its increase in gravitational potential energy is:

a) 1280 J
b) 40 slug·ft
c) 1280 ft lb
d) 41 000 ft lb

10. What is the average force on a bridge piling as it penetrates 4 in under the impact of a 1000 lb hammer which is going 15 ft/s as it hits?

11. What power does an automobile engine develop if it must overcome 400 lb of friction when moving at 50 mi/h?

NAME _____

TEST C

Module M 8 ENERGY & POWER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Work will always be done on an object if an external force causes motion perpendicular to the direction of the force.

T - F 2. The amount of gravitational potential energy an object has depends on how far it is above the ground.

T - F 3. One erg equals one one-hundred-thousandths of one joule.

T - F 4. If 1 N of force stretches a spring 1.5 cm, then 3.5 N will stretch it 2.35 cm.

T - F 5. Energy cannot be created or destroyed. It can only be transformed from one form to another.

6. The unit of power expressed in fundamental MKS units is:

a) ft·lb/s
b) kg m/s
c) horsepower
d) kg m^2/s^3

7. A 64 lb weight is lifted 20 ft in 8 s. The power developed is:

a) 160 hp
b) 160 ft lb/min
c) 0.29 hp
d) 0.29 kW

8. An automobile traveling 45 mi/h (66 ft/s) and has a kinetic energy of 260 000 ft·lb. What is the weight of the automobile?

a) 119 slug
b) 3820 lb
c) 2520 lb
d) 7880 lb

9. A 64 kg mass is lifted 8 m. Its increase in gravitational potential energy is:

a) 512 J
b) 5020 ft lb
c) 16 400 J
d) 5020 J

10. What is the average force on a bridge piling as it penetrates 12 cm under the impact of a 300 kg hammer going 6.25 m/s as it hits?

(OVER)

NAME_____

TEST C

Module M 8 ENERGY & POWER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Work will always be done on an object if an external force causes motion perpendicular to the direction of the force.

T - F 2. The amount of gravitational potential energy an object has depends on how far it is above the ground.

T - F 3. One erg equals one one-hundred-thousandths of one joule.

T - F 4. If 1 N of force stretches a spring 1.5 cm, then 3.5 N will stretch it 2.35 cm.

T - F 5. Energy cannot be created or destroyed. It can only be transformed from one form to another.

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a) ft·lb/s
b) kg m/s
c) horsepower
d) kg m^2/s^3

7. A 64 lb weight is lifted 20 ft in 8 s. The power developed is:

a) 160 hp
b) 160 ft lb/min
c) 0.29 hp
d) 0.29 kW

8. An automobile traveling 45 mi/h (66 ft/s) and has a kinetic energy of 260 000 ft·lb. What is the weight of the automobile?

a) 119 slug
b) 3820 lb
c) 2520 lb
d) 7880 lb

9. A 64 kg mass is lifted 8 m. Its increase in gravitational potential energy is:

a) 512 J
b) 5020 ft lb
c) 16 400 J
d) 5020 J

10. What is the average force on a bridge piling as it penetrates 12 cm under the impact of a 300 kg hammer going 6.25 m/s as it hits?

(OVER)

NAME_____

TEST D

Module M 8 ENERGY & POWER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Just because an object is moving doesn't mean that work is being done on it.

T - F 2. The amount of gravitational potential energy an object has depends on how far it is above the zero reference level.

T - F 3. One watt equals one joule per second.

T - F 4. If the spring constant for a certain spring is 12.4 N/m, it would take 0.34 N to stretch it 4.2 cm.

T - F 5. Energy is destroyed only when work is done overcoming friction.

6. The unit of power expressed in fundamental cgs units is:

a) $g \cdot cm^2/s^2$
b) $ft \cdot lb/s$
c) horsepower
d) $g \cdot s/cm^2$

7. A 64 N weight is lifted 20 m in 8 s. The power developed is:

a) 0.16 hp
b) 160 hp
c) 160 J
d) 0.16 kW

8. A bullet has a mass of 25 g and a muzzle velocity of 450 m/s. Its kinetic energy is:

a) 2.53×10^3 J
b) 25.3 J
c) 2 530 000 J
d) 2.53×10^6 erg

9. A 64 lb weight is lifted until its gravitational potential energy increases 2540 ft lb. How high was it lifted?

a) 0.81 ft
b) 1.24 ft
c) 39.7 ft
d) 1270 ft

10. A spring with a force constant of 3 lb/in is compressed 3 in. If a 2 lb ball rests against the spring, how fast will the ball be moving when the spring is released? Assume all the spring energy is transferred to the ball as kinetic energy.

11. How much work in joules can a 0.75 kW (output) electric motor do in 5 min?

NAME_____

TEST E

Module M 8 ENERGY & POWER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. A force acts on an object. This doesn't necessarily mean that work is being done on the object.

T - F 2. Every moving object possesses kinetic energy.

T - F 3. One watt equals one joule·second.

T - F 4. Ten watts of power applied to an object weighing two newtons would lift it fifteen meters in three seconds.

T - F 5. Energy can be created in such equipment as that used by power companies in the production of electricity.

6. The unit of power expressed in fundamental British units is:

a) horsepower
b) ft·lb/s
c) ft/lb/s
d) horsepower/s

7. A 64 kg mass is lifted 20 m in 8 s. The power developed is:

a) 1570 kW
b) 1570 W
c) 1570 ft lb/s
d) 1.57 hp

8. A bullet has a weight of 0.8 oz and a muzzle velocity of 1500 ft/s. Its kinetic energy is:

a) 56 300 ft lb
b) 28 100 ft lb
c) 1760 ft lb
d) 1.17 ft lb

9. A spring has a force constant of 3160 N/m. A force of 250 N will stretch it:

a) 7.9 cm
b) 0.775 m
c) 12.6 cm
d) 12.6 m

10. A 4000 lb automobile going 66 ft/s hits a concrete bridge structure. What is the average force on the automobile if its front end crumples, bends, and twists backwards so the center of gravity moves forward 10 in during the impact? Assume the bridge structure doesn't move.

11. How much work in foot·pounds can a 25 hp engine do in 5 min?

NAME_____

TEST A (T)

Module M 8 ENERGY & POWER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Work will always be done on an object if an external force causes motion parallel to the direction of the force.

T - F 2. Not all moving objects posses kinetic energy.

T - F 3. One joule equals one foot-pound.

T - F 4. In lifting a TV set from the floor to a table, the work done is: The mass of the set times the height of the table.

T - F 5. Engines, motors, furnaces, and generators are devices that transform energy from one form to another.

6. The unit of energy expressed in cgs units is:

a) dynes
b) ft lb
c) joules
d) erg

7. A 64 lb weight is lifted 20 ft. The work done is:

a) 1280 J
b) 12 500 ft·lb
c) 12 800 erg
d) 1280 ft·lb

8. An 1800 kg automobile is traveling 60 km/h (16.67 m/s). What is its kinetic energy?

a) 2 450 000 ft·lb
b) 2 450 000 J
c) 250 000 J
d) 250 000 ft·lb

9. A force of 5.5 lb will stretch a stiff spring 0.25 in. The spring constant is:

a) 264 lb/ft
b) 22 lb/ft
c) 0.69 lb/in
d) 704 lb/in

10. What average force would be acting on a 1 oz bullet as it penetrates wood to a depth of 4 in? It speed just before impact is 1000 ft/s.

(OVER)

11. An elevator and its contents have a mass of 1500 kg. It moves 150 m to the top of a building in 120 s. What power is required?

NAME_____

TEST B (T)

Module M 8 ENERGY & POWER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. If an object moves then work is being done on it.

T - F 2. Objects that are under tension (stretched), compression or torsion (twisted), possess elastic potential energy.

T - F 3. One joule equals one newton per meter.

T - F 4. If one newton of force stretches a spring 1.5 cm, then 3.5 N will stretch it 5.25 cm.

T - F 5. When work is done against friction, energy is transformed from one form to another.

6. The unit of energy expressed in British units is:

a) ft·lb
b) ft/lb
c) erg
d) joule

7. A 64 kg mass is lifted 20 m. The work done is:

a) 1280 J
b) 12 500 J
c) 12 800 erg
d) 1280 ft lb

8. An automobile is traveling 60 km/h (16.67 m/s) and has a kinetic energy of 200 000 J. What is the mass of the automobile?

a) 24 000 kg
b) 111 kg
c) 14 100 N
d) 1440 kg

9. A 64 lb weight is lifted 20 ft. Its increase in gravitational potential energy is:

a) 1280 J
b) 40 slug·ft
c) 1280 ft lb
d) 41 000 ft lb

10. What is the average force on a bridge piling as it penetrates 4 in under the impact of a 1000 lb hammer which is going 15 ft/s as it hits?

11. What power does an automobile engine develop if it must overcome 400 lb of friction when moving at 50 mi/h?

11. A conveyor lifts gravel to the top of a batch plant for loading into cement trucks. The vertical height is 60 ft. If the conveyor will move 20 ton in 8 minutes, what horsepower is required?

NAME_____

TEST C (T)

Module M 8 ENERGY & POWER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Work will always be done on an object if an external force causes motion perpendicular to the direction of the force.

T - F 2. The amount of gravitational potential energy an object has depends on how far it is above the ground.

T - F 3. One erg equals one one-hundred-thousandths of one joule.

T - F 4. If 1 N of force stretches a spring 1.5 cm, then 3.5 N will stretch it 2.35 cm.

T - F 5. Energy cannot be created or destroyed. It can only be transformed from one form to another.

6. The unit of power expressed in MKS units is:

a) ft·lb/s
b) kilowatt
c) horsepower
d) watt

7. A 64 lb weight is lifted 20 ft in 8 s. The power developed is:

a) 160 hp
b) 160 ft lb/min
c) 0.29 hp
d) 0.29 kW

8. An automobile traveling 45 mi/h (66 ft/s) and has a kinetic energy of 260 000 ft·lb. What is the weight of the automobile?

a) 119 slug
b) 3820 lb
c) 2520 lb
d) 7880 lb

9. A 64 lb object is lifted 8 ft. Its increase in gravitational potential energy is:

a) 512
b) 5020 ft lb
c) 16 400
d) 5020 J

10 What is the average force on a bridge piling as it penetrates 12 cm under the impact of a 300 kg hammer going 6.25 m/s as it hits?

(OVER)

NAME_____

TEST D (T)

Module M 8 ENERGY & POWER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Just because an object is moving doesn't mean that work is being done on it.

T - F 2. The amount of gravitational potential energy an object has depends on how far it is above the zero reference level.

T - F 3. One watt equals one joule per second.

T - F 4. If the spring constant for a certain spring is 12.4 N/m, it would take 0.34 N to stretch it 4.2 cm.

T - F 5. Energy is destroyed only when work is done overcoming friction.

6. The unit of power expressed in fundamental cgs units is:

a) erg/s
b) watts
c) horsepower
d) W/s

7. A 64 N weight is lifted 20 m in 8 s. The power developed is:

a) 0.29 hp
b) 290 hp
c) 2.9 hp
d) 29 kW

8. A bullet has a mass of 25 g and a muzzle velocity of 450 m/s. Its kinetic energy is:

a) 2.530 J
b) 25.3 J
c) 2 530 000 J
d) 2 530 000 erg

9. A 64 lb weight is lifted until its gravitational potential energy increases 2540 ft lb. How high was it lifted?

a) 0.81 ft
b) 1.24 ft
c) 39.7 ft
d) 1270 ft

10. A spring with a force constant of 3 lb/in is compressed 3 in. If a 2 lb ball rests against the spring, how fast will the ball be moving when the spring is released? Assume all the spring energy is transferred to the ball as kinetic energy.

11. How much work in ft·lb can a 0.75 hp (output) electric motor do in 5 min?

NAME_____

TEST E (T)

Module M 8 ENERGY & POWER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. A force acts on an object. This doesn't necessarily mean that work is being done on the object.

T - F 2. Every moving object possesses kinetic energy.

T - F 3. One watt equals one joule·second.

T - F 4. Ten watts of power applied to an object weighing two newtons would lift it fifteen meters in three seconds.

T - F 5. Energy can be created in such equipment as that used by power companies in the production of electricity.

6. The unit of power expressed in British units is:

a) watts
b) ft·lb/s
c) ft/lb/s
d) horsepower/s

7. A 64 lb mass is lifted 8 ft in 20 s. The power developed is:

a) 4.7 hp
b) 0.0047 hp
c) 1.49 hp
d) 4.7 kW

8. A bullet has a weight of 0.8 oz and a muzzle velocity of 1500 ft/s. Its kinetic energy is:

a) 56 300 ft lb
b) 28 100 ft lb
c) 1760 ft lb
d) 1.17 ft lb

9. A spring has a force constant of 3160 N/m. A force of 250 N will stretch it:

a) 7.9 cm
b) 0.775 m
c) 12.6 cm
d) 12.6 m

10. A 4000 lb automobile going 66 ft/s hits a concrete bridge structure. What is the average force on the automobile if its front end crumples, bends, and twists backwards so the center of gravity moves forward 10 in during the impact? Assume the bridge structure doesn't move.

11. How much work in foot·pounds can a 25 hp engine do in 5 min?

TEST ANSWER KEYS (T)

Module M 8 ENERGY & POWER

PROBLEM	A	B	C	D	E
1	T	F	F	T	T
2	F	T	F	T	T
3	F	F	F	T	F
4	F	T	F	F	T
5	T	T	T	F	F
6	d	a	d	a	b
7	a	b	c	d	b
8	c	d	b	a	c
9	a	c	d	c	a
10	2930 lb	10 500 lb	48 800 N	6 ft/s or 72 in/s	327 000 lb
11	18.4 kW	53.3 hp	9.1 hp	124 000 ft lb	4 130 000 ft lb

GRADING

NUMBER WRONG	GRADE
0	100
1	91
2	82
3	73
4	64
5	55
6	46

DATA SHEET

Module P 2 FLUIDS I (STATICS)

EXPERIMENT I SPECIFIC GRAVITY

Table 1

weight	in air	in water	in unknown liquid
Aluminum	g	g	g
Brass	g	g	g
Iron	g	g	g

Table 2

	weight in air	loss of weight in water	loss of weight in unknown
Aluminum	g	g	g
Brass	g	g	g
Iron	g	g	g

Table 3

Specific gravity	Calculated	Tables	Error
Aluminum			%
Brass			%
Iron			%

Table 4 Specific gravity of unknown liquid

	Sp gr
Aluminum	
Brass	
Iron	

Average_____

Step 14_____

Step 15_____ %

DATA SHEET

Module P 2 FLUIDS I (STATICS)

EXPERIMENT II THE MANOMETER

Steps 5 - 8

Diameter (cm)	Pressure head (cm Hg)

Step 9 _____ cm H_2O

Step 10 _____ dynes/cm^2

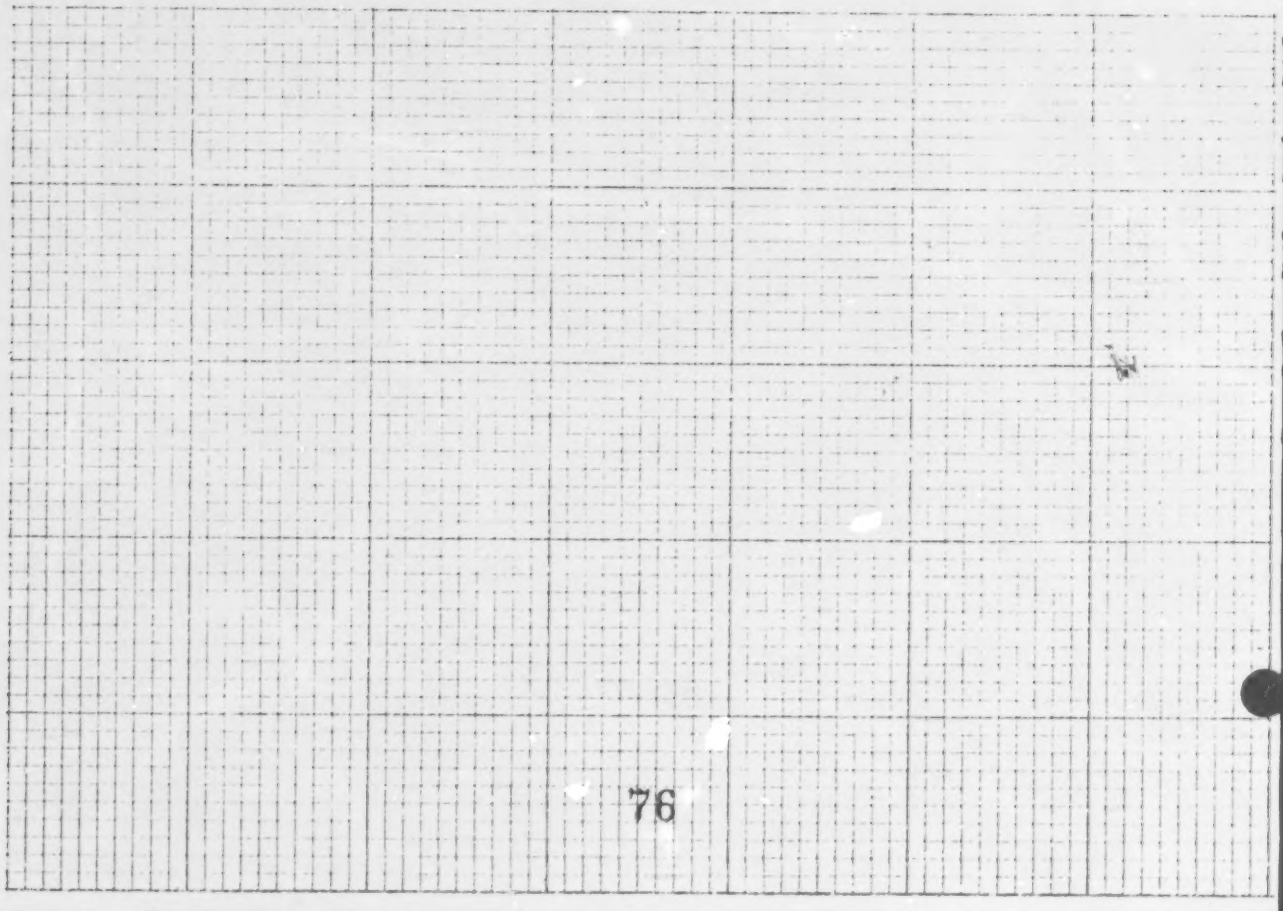
Step 11 _____ cm Hg

Step 12 _____ cm Hg

Step 13 _____ %

Step 15

Step 14



NAME_____

TEST A

Module P 2 FLUIDS I (STATICS)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The density of water is 1 kg/m^3.

T - F 2. An absolute pressure of 3 atmospheres is equivalent to 2 atmospheres gauge pressure.

T - F 3. The larger specific gravities (numbers) are located on bottom of a hydrometer scale.

T - F 4. The pressure under an object can be decreased by decreasing the area the object rests on.

T - F 5. The pressure at the bottom of a container filled with liquid does not depend on the pull of gravity.

6. A solid object has a density of 145 lb/ft^3. Its specific gravity is:

a) 2.3 c) 0.43

b) 4.3 d) 5.2

7. Which of the following does not correspond to standard atmospheric pressure or pressure head?

a) 14.7 lb/in^2 c) 76 cm (mercury)

b) 34 ft (water) d) 62.4 lb/in^2

8. What is the pressure in newtons per square meter measured with a mercury manometer if the levels are 34.2 cm and 21.9 cm? The density of mercury is 13.6 g/cm^3.

a) 1670 c) 1.67×10^5

b) 16 400 d) 1.64×10^6

9. A force of 188 lb is spread over an area of 9 in^2. What is the pressure in pounds per square inch?

a) 0.048 c) 20.9

b) 2.1 d) 1690

OVER

10. A 25 in^2 surface is located 10 ft under water, what is the force on this surface?

NAME_____

TEST B

Module P 2 FLUIDS I (STATICS)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The density of water is 0.036 lb/in^3.

T - F 2. An absolute pressure of 30 lb/in^2 is equivalent to 44.7 lb/in^2 gauge pressure.

T - F 3. The smaller specific gravities (numbers) are located on the bottom of a hydrometer scale.

T - F 4. When a person shifts his weight from both feet to just one, the pressure under that foot increases.

T - F 5. The pressure at the bottom of a container filled with liquid depends on the density of the liquid.

6. A solid object weighs 170 lb in water and 107.6 lb under water. Its specific gravity is:

a) 1.6 c) 5.3

b) 2.7 d) 0.63

7. Which of the following does not correspond to standard atmospheric pressure or pressure head?

a) 0.036 lb/in^2 c) 1.013×10^5 N/m^2

b) 34 ft (water) d) 30 in (mercury)

8. What is the difference in levels in centimeters if the pressure is 24 600 $dynes/cm^2$? The manometer contains water.

a) 24.6 c) 7.69

b) 3.94 d) 25.1

9. A pressure of 35 lb/in^2 is applied by a force of 1 ton. What area is involved in square feet?

a) 2.52 c) 0.4

b) 57 d) 0.0175

10. A force of 60 lb acts on a 12 in^2 surface located under water. At what depth is the surface?

NAME_____

TEST C

Module P 2 FLUIDS I (STATICS)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The density of water 62.4 lb/ft^3.

T - F 2. A gauge pressure of 30 lb/in^2 is equivalent to 44.7 lb/in^2 absolute.

T - F 3. The specific gravity of a substance is just a number and does not have any units.

T - F 4. When a person shifts his weight from both feet to just one, the pressure under that foot decreases.

T - F 5. The pressure at the bottom of a container filled with liquid does not depend on the depth of the liquid.

6. A brass object has a specific gravity of 8.7. What is its density?

a) 8.7 g/cm^3 c) 0.31 g/cm^3

b) 542 lb/in^3 d) 8700 lb/ft^3

7. Which of the following is not a pressure unit?

a) lb/in^2 c) cm (mercury)

b) N/m^2 d) $dynes/cm^2$

8. What is the difference in levels in inches if the pressure is 7.5 lb/in^2. The manometer contains mercury which has a density of 0.49 lb/in^3.

a) 3.7 c) 77

b) 15.3 d) 61

9. An average pressure is 14.7 lb/in^2 on a door with an area of 32 ft^2. What force in pounds is exerted on the door?

a) 470 c) 66.2

b) 0.0032 d) 67 700

10. A force of 400 N acts on a 60 cm^2 surface located under water. At what depth is the surface?

NAME _____

TEST D

Module P 2 FLUIDS I (STATICS)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The density of water is 1 g/cm^3.

T - F 2. An absolute pressure of 30 lb/in^2 is equivalent to 44.7 lb/in^2 gauge pressure.

T - F 3. A hydrometer sinks deeper in more dense liquids to displace its own weight.

T - F 4. Increasing the area of the base of an object and increasing its weight will <u>both</u> tend to increase the pressure under the base.

T - F 5. The fluid at the bottom of a container is under the same pressure as the fluid at the top.

6. Gasoline has a specific gravity of 0.67. Its density in kilograms per liter is:

a) 5.61 c) 0.67

b) 2.45 d) 670

7. Which of the following devices does not measure either pressure or pressure head?

a) Bourdon gauge c) Manometer

b) Hydrometer d) Barometer

8. What is the difference in levels in centimeters if the pressure is 35 000 N/m^2. The manometer contains mercury which has a density of 13 600 kg/m^3.

a) 26.3 c) 2.57

b) 39.5 d) 13.2

9. A pressure of 2400 N/m^2 is applied by a force of 800 N. What area in square centimeters is involved?

a) 3 c) 0.33

b) 30 000 d) 3300

10. A difference in levels in a manometer is 18 in. If the pressure being measured is 8.8 lb/in^2, what is the specific gravity of the liquid?

NAME_____

TEST E

Module P 2 FLUIDS I (STATICS)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The density of water 1000 g/cm^3.

T - F 2. Absolute pressures are measured in metric units while gauge pressures are British units.

T - F 3. Specific gravity and mass density are two names for the same quantity.

T - F 4. Decreasing the area of the base of an object and increasing its weight will <u>both</u> tend to increase the pressure under the base.

T - F 5. The pressure at a depth of 1 ft in water is 0.433 lb/in^2. At 10 ft the water pressure would be 4.33 lb/in^2.

6. Aluminum has a density of 0.1 lb/in^3. Its specific gravity is:

a) 1.2 c) 0.1

b) 3.8 d) 2.7

7. Which of the following is not a pressure head unit?

a) cm (Hg) c) ml (alcohol)

b) ft (H_2O) d) cm (alcohol)

8. What is the pressure in dynes per square centimeter if the manometer levels are 7.1 cm and 26.4 cm? The manometer contains water.

a) 18 900 c) 189

b) 19.3 d) 618

9. An average pressure on a piston is 110 lb/in^2. If the piston has an area of 12.6 in^2, what is the average force in pounds?

a) 8.7 c) 870

b) 1390 d) 139

10. The specific gravity of mercury is 13.6. The difference in levels in a mercury manometer is 14 in. What is the pressure in pounds per square inch?

TEST ANSWER KEYS

Module P 2 FLUIDS I (STATICS)

PROBLEM	A	B	C	D	E
1	F	T	T	T	F
2	T	F	T	F	F
3	T	F	T	F	F
4	F	T	F	F	T
5	F	T	F	F	T
6	a	b	a	c	d
7	d	a	c	b	c
8	b	d	b	a	a
9	c	c	d	d	b
10	108 lb	11.6 ft	6.8 m	13.6	6.85 lb/in^2

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

DATA SHEET

Module P 3 FLUIDS II (DYNAMICS)

Step 9 volume of water caught in flask _____ cm^3

time _____ s

Step 10 diameter of tube at point c _____ cm

Step 11 area of tube at point c _____ cm^2

Step 12 rate of flow _____ cm^3/s

Step 13 area of tube at point b _____ cm^2

Step 14 diameter of tube at point b _____ cm

Step 15 error _____ %

Step 16 velocity at point c _____ cm/s

velocity at point b _____ cm/s

Calculations:

DATA SHEET

Module # 3 FLUIDS II (DYNAMICS)

EXPERIMENT II DIGIAC 844 Training Console

DO NOT WRITE IN THE GREEN MANUAL. RECORD ALL OBSERVATIONS AND DATA ON THIS SHEET.

Experiment 1

Experiment 2

Experiment 3

Experiment 4

Experiment 5

Experiment 6

Experiment 7

NAME_____

TEST A

Module P 3 FLUIDS II (DYNAMICS)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Pressure head = total head - velocity head - friction head.

T - F 2. The velocity of flow out of a hole in the bottom of a tank depends on the density of the liquid.

T - F 3. Eddy currents are found in streamline flow only.

T - F 4. Flow of liquid through a needle valve can go either direction.

T - F 5. In a section of pipe in which friction losses are negligible, where the velocity is high, the pressure is high and where the velocity is low, the pressure is low.

6. Fluid flows at a rate of 1 ℓ/s in a pipe at a velocity of 400 cm/s. What is the cross-sectional area of the pipe in square centimeters?

a) 2.5 c) 400

b) 0.40 d) 76.2

7. If 250 ℓ of fuel can be pumped in 6.5 min, what is the rate of flow in liters per second.

a) 640 c) 38.5

b) 0.64 d) 136

8. If fuel moves at a velocity of 40 cm/s in a 2 cm pipe, how much time is required for 200 ℓ to move past a point is the pipe?

NAME_____

TEST B

Module P 3 FLUIDS II (DYNAMICS)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Pressure head = velocity head + friction head + total head.

T - F 2. The rate of flow out of a hole in the bottom of a tank depends on the density of the liquid.

T - F 3. In streamline flow every particle of fluid that passes a certain point will follow the same path.

T - F 4. Flow of liquid through a needle valve can go only in the forward direction.

T - F 5. In a section of pipe in which friction losses are negligible, where the velocity is high the pressure will be low and where the velocity is low the pressure is high.

6. What is the rate of flow in cubic feet per minute of air flowing in a duct at a speed of 15 ft/s? The duct is rectangular with dimensions 24 x 8 in.

a) 845 c) 20

b) 2880 d) 1200

7. How much time in seconds is required to move 20 gal of gasoline if it flows at a rate of 4.5 gal/min?

a) 267 c) 0.23

b) 4.4 d) 13.5

8. If air moves at a velocity of 9 ft/s in a 24 x 8 in duct, how many cubic feet of air will flow past a point in the duct in 5 min?

NAME _____

TEST C

Module P 3 FLUIDS II (DYNAMICS)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Loss of pressure head due to velocity always increases with distance from the pumping station.

T - F 2. The velocity of flow out of a hole in the bottom of a tank depends on the pressure head.

T - F 3. In turbulant flow every particle of a fluid that passes a certain point will follow the same path.

T - F 4. A pressure relief valve is used in a by-pass circuit. It opens only if the pressure in the main hydraulic circuit exceeds a predetermined setting. This maintains a nearly constant pressure in the main circuit.

T - F 5. Bernoulli's principle is a special application of the law of conservation of energy.

6. Fluid flows at a rate of 100 ℓ/min in a pipe of 3 cm diameter. Its velocity in centimeters per second is:

a) 0.96 c) 236

b) 33.3 d) 300

7. If fuel flows at a rate of 8.25 gal/min, how much will flow in 2 hr 15 min?

a) 3.7 c) 220

b) 18.6 d) 1110

8. If air moves at a velocity of 9 ft/s in a duct, what is the cross-sectional area of the duct if 1800 ft^3 moves past a point in 5 min?

NAME_____

TEST D

Module P 3 FLUIDS II (DYNAMICS)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Loss of pressure head due to friction always increases with distance from the pumping station.

T - F 2. The velocity of flow out of a hole in the bottom of a tank depends on the acceleration of gravity.

T - F 3. Friction head loss measured at a point is less if the flow in the pipe leading up to the point is streamline rather than turbulent.

T - F 4. A needle valve can always be used in place of a check valve and will serve the same purpose.

T - F 5. Bernoulli's principle is a special application of Archimedes' principle.

6. Air flows at a rate of 1420 ft^3/min in a duct at a velocity of 12 ft/s. What is the cross-sectional area of the duct in square feet?

a) 118 c) 1.97

b) 3.7 d) 17 000

7. If 1600 ft^3 of air can be moved in 3.5 min, what is the rate of flow in cubic feet per second?

a) 7.62 c) 5600

b) 457 d) 93

8. If air moves at a velocity 8 ft/s in a 24 x 24 in duct how many cubic feet of air will flow past a point in the duct in 1 hr?

NAME_____

TEST E

Module P 3 FLUIDS II (DYNAMICS)

Read each question cardfully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Total head = pressure head - velocity head - friction head.

T - F 2. The rate of flow out of a hole in the bottom of a tank depends on the size (area) of the hole.

T - F 3. Friction head loss measured at a point is less if the flow in the pipe leading up to the point is turbulant rather than streamline.

T - F 4. Pressure relief valves and check valves can be used interchanagably. They serve the same function.

T - F 5. A venturi is a short pipe with flaring ends and a constricted middle. The pressure of any fluid flowing through it will always be less in the constricted center section.

6. What is the rate of flow in liters per second of a fluid flowing at 35 cm/s? The diameter of the pipe is 3.4 cm.

a) 0.12 c) 1.27

b) 0.32 d) 29.2

7. How much time is required (in minutes) to fill a 20 000 ℓ tank at the rate of 12 ℓ/s?

a) 1670 c) 66.7

b) 4000 d) 27.8

8. If fuel moves at a velocity of 60 cm/s in a 1 cm pipe, how much time is required for 1000 ℓ to move past a point in the pipe?

TEST ANSWER KEYS

Module P 3 FLUIDS II (DYNAMICS)

PROBLEM	A	B	C	D	E
1	T	F	F	T	F
2	F	F	T	T	T
3	F	T	F	T	F
4	T	F	T	F	F
5	F	T	T	F	T
6	a	d	c	c	b
7	b	a	d	a	d
8	26.5 min OR 0.44 h	3600 ft^3	0.67 ft^2	115 000 ft^3	5.9 hr

GRADING

NUMBER WRONG	GRADE
0	100
1	88
2	76
3	64
4	52
5	40
6	28

DATA SHEET

Module M 6 FRICTION

Steps 1 - 9

	WEIGHT OF BLOCK	FRICTION	COEFFICIENT OF FRICTION
1.			
2.			
3.			
4.			
5.			
			AVERAGE

Step 10

Angle of repose _____

Coefficient of friction _____

Comparison _____ _____ %

Steps 11 - 14

Angle of incline _____

Force P ($P = W \sin \theta$) _____

Force N ($N = W \cos \theta$) _____

frictional force f ($f = \mu N$) _____

Calculated force F ($F = f + P$) _____

Measured force F _____

Comparison _____ %

Steps 15 - 18

Area ratio _____ %

Friction ratio _____ %

Answer to question (step 18)

CALCULATIONS:

DATA SHEET (T)

Module M 6 FRICTION

Steps 1 - 9

	WEIGHT OF BLOCK	FRICTION	COEFFICIENT OF FRICTION
1.			
2.			
3.			
4.			
5.			
			AVERAGE

Steps 10 - 12

Area ratio_____%

Friction ratio_____%

Answer to question (Step 12)

Step 13

	WEIGHT OF BLOCK	FRICTION	COEFFICIENT OF FRICTION
1.			
2.			
3.			
4.			
5.			
			AVERAGE

CALCULATIONS:

NAME_____

TEST A

Module M 6 FRICTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The force of friction on an object on an inclined plane is proportional to the object's weight.

T - F 2. Changing the angle of an inclined plane will not change the force of friction between the incline and the object sliding on it.

T - F 3. The force of friction is always perpendicular to the normal force acting on an object.

T - F 4. Real contact area usually exceeds the apparent area.

T - F 5. A 325 lb weight on a 23° incline has a normal component of 299 lb.

6. Metal containers at a manufacturing plant slide down a 33.6° incline at uniform speed. The coefficient of friction is:

a) 0.883
b) 0.664
c) 0.553
d) cannot be calculated

7. A force of 45 lb is required to slide a TV set across a tiled floor. If the coefficient of kinetic friction is 0.51, how much does the TV set weigh in pounds?

a) 22.9
b) 127
c) 66.1
d) 88.2

8. A crate is pulled up an 18° incline on which the coefficient of limiting and kinetic friction are 0.48 and 0.32, respectively. If the crate weighs 800 lb, what force up the incline will start the crate moving?

NAME_____

TEST B

Module M 6 FRICTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The force of friction is proportional to the force pressing the two surfaces together.

T - F 2. The apparent area between sliding surfaces determines the amount of friction.

T - F 3. Lubricants applied between sliding surfaces will reduce the coefficient of friction.

T - F 4. Frictional forces always act in a direction to oppose motion.

T - F 5. A 415 lb weight on a 42° incline has a normal force of 278 lb.

6. Metal containers at a manufacturing plant slide down a 23.6° incline at uniform speed. The coefficient of friction is:

a) 0.437
b) 0.400
c) 0.916
d) cannot be calculated

7. The coefficient of limiting friction between a rubber tire and dry concrete is 0.72. What frictional force in pounds would have to be overcome to make the car slide if it weighs 4200 lb?

a) 302
b) 583
c) 3020
d) 5830

8. A crate is pulled up a 29° incline on which the coefficients of static and kinetic friction are 0.56 and 0.35, respectively. If the crate weighs 600 lb, what force up the incline will keep it moving once started?

NAME_____

TEST C

Module M 6 FRICTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The force of friction depends on the apparent area between the sliding surfaces.

T - F 2. The coefficient of friction does not change when the force pressing the two surfaces together is increased.

T - F 3. The coefficient of friction is equal to the angle of repose.

T - F 4. Real contact area is usually a small fraction of the apparent area unless the surfaces are highly polished.

T - F 5. An 87.5 lb weight on a 22° incline has a normal force of 32.8 lb.

6. Metal containers at a manufacturing plant slide down an incline at uniform speed on which the coefficient of friction is 0.795. The angle of the incline is:

a) 52.6° c) 37.3°
b) 42.9° d) 38.5°

7. The coefficient of rolling friction betwen a rubber tire and dry concrete is 0.04. What is the frictional force in pounds on a 4600 lb car, not including air drag?

a) 115 000 c) 184
b) 115 d) 1840

8. A crate is pulled up a 23° incline. A force of 625 lb will start the 800 lb crate moving. What is the coefficient of limiting friction?

NAME _____

TEST D

Module M 6 FRICTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The force of friction depends on the kinds of materials and the roughness of the sliding surfaces.

T - F 2. The force of friction increases when the force pressing the two surfaces together is increased.

T - F 3. The force of friction is equal to the tangent of the angle of repose.

T - F 4. A 655 lb weight on a 52° incline has a normal force of 516 lb.

T - F 5. Lubricants will reduce both kinetic friction and limiting friction.

6. Metal containers at a manufacturing plant slide down an incline at uniform speed on which the coefficient of friction is 0.661. The angle of the incline is:

a) 33.5° c) 52.3°
b) 41.6° d) 37.7°

7. What is the minimum force in pounds required to keep a 125 lb wooden crate moving over a wooden floor? The coefficient of limiting friction is 0.35 and the coefficient of kinetic friction is 0.28.

a) 43.75 c) 125
b) 35.0 d) 446

8. A crate is pulled up a 23° incline. A force of 525 lb is required to keep the 800 lb crate moving. What is the coefficient of kinetic friction?

NAME_____

TEST E

Module M 6 FRICTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The force of friction is always the same as the externally applied force acting on the sliding object.

T - F 2. The coefficient of friction increases when the force pressing the two surfaces together increases.

T - F 3. The coefficient of rolling friction is usually less than that for sliding friction regardless of the normal force.

T - F 4. Limiting friction is usually greater than kinetic friction if everything else remains the same.

T - F 5. Friction is a phenomenon mankind could well do without. We try to reduce it in every situation in which we find it.

6. Metal containers at a manufacturing plant slide down an incline at uniform speed on which the coefficient of friction is 0.495. The angle of the incline is:

a) 60.3° c) 38.4°
b) 29.7° d) 26.3°

7. A frictional force on an 3800 lb car, not including air drag is 245 lb. What is the coefficient of kinetic friction?

a) 0.0645 c) 0.155
b) .645 d) 0.0155

8. A 400 lb crate sits on a 20° incline on which the coefficient of limiting friction is 0.45. If the crate is released, will it slide down the incline? Show your calculations.

NAME _____

TEST A (T)

Module M 6 FRICTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The force of friction on an object is proportional to the object's weight.

T - F 2. Changing the weight of an object will not change the force of friction between the object and the surface it is sliding on.

T - F 3. The force of friction is always perpendicular to the normal force acting on an object.

T - F 4. Real contact area usually exceeds the apparent area.

T - F 5. A 325 lb weight on a horizontal surface has a normal force of 325 lb.

6. On ice, a 4200 lb automobile will skid if the sideways force is 672 lb. The coefficient of friction is:

a) .63 c) 0.0
b) 0.16 d) cannot be calculated

7. A force of 45 lb is required to slide a TV set across a tiled floor. If the coefficient of kinetic friction is 0.51, how much does the TV set weigh in pounds?

a) 22.9 c) 66.1
b) 127 d) 88.2

8. A crate is pulled on a surface on which the coefficient of limiting and kinetic friction are 0.48 and 0.32, respectively. If the crate weighs 800 lb, what force will start the crate moving?

NAME_____

TEST B (T)

Module M 6 FRICTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The force of friction is proportional to the force pressing the two surfaces together.

T - F 2. The apparent area between sliding surfaces will reduce the amount of friction.

T - F 3. Lubricants applied between sliding surfaces will reduce the coefficient of friction.

T - F 4. Frictional forces always act in a direction to oppose motion.

T - F 5. A 415 lb weight sliding on a surface has a frictional force of 278 lb. The coefficient of kinetic friction is 0.76.

6. On ice, a 4200 lb automobile requires a braking force of no more than 632 lb or skidding will begin. What is the coefficient of friction between tires and ice?

a) 0.15
b) 0.66
c) 0.015
d) cannot be calculated

7. The coefficient of limiting friction between a rubber tire and dry concrete is 0.72. What frictional force in pounds would have to be overcome to make the car slide if it weighs 4200 lb?

a) 302
b) 583
c) 3020
d) 5830

8. A crate is pulled along a surface on which the coefficients of static and kinetic friction are 0.56, and 0.35 respectively. If the crate weighs 600 lb, what force will keep it moving once it has started?

NAME_____

TEST C (T)

Module M 6 FRICTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The force of friction depends on the apparent area of the sliding surfaces.

T - F 2. The coefficient of friction does not change when the force pressing the two surfaces together is increased.

T - F 3. The coefficient of friction is equal to the force pressing the two surfaces together.

T - F 4. Real contact area is usually a small fraction of the apparent area unless the surfaces are highly polished.

T - F 5. An 87.5 lb weight sliding on a surface has a frictional force of 32.8 lb. The coefficient of friction is 0.73.

6. The frictional force acting on a car when it is skidding (brakes locked) is 2460 lb. The coefficient of kinetic friction between tire and road is 0.78. What is the weight of the car?

a) 2460 lb c) 4150 lb
b) 1920 lb d) 3150 lb

7. The coefficient of rolling friction between a rubber tire and dry concrete is 0.04. What is the frictional force in pounds on a 4600 lb car, not including air drag?

a) 115 000 c) 184
b) 115 d) 1840

8. A crate is pulled along the floor. A force of 625 lb will start the 800 lb crate moving. What is the coefficient of limiting friction?

NAME _____

TEST D (T)

Module M 6 FRICTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The force of friction depends on the kind of material and the roughness of the sliding surfaces.

T - F 2. The force of friction increases when the force pressing the two surfaces together is increased.

T - F 3. The force of friction is equal to the product of coefficient of friction and the weight of the object on a horizontal surface.

T - F 4. A 655 lb weight sliding on a surface has a frictional force of 516 lb. The coefficient of kinetic friction is 0.079.

T - F 5. Lubricants will reduce both kinetic friction and limiting friction.

6. The frictional force acting on a car when it is skidding on ice is 544 lb. If the coefficient of kinetic friction is 0.17, what is the weight of the car?

a) 3200 lb c) 924 lb
b) 4200 lb d) 2700 lb

7. What is the minimum force in pounds required to keep a 125 lb wooden crate moving over a wooden floor? The coefficient of limiting friction is 0.35 and the coefficient of kinetic friction is 0.28.

a) 43.75 c) 125
b) 35.0 d) 446

8. A crate is pulled along the floor. A force of 525 lb is required to keep the 800 lb crate moving. What is the coefficient of kinetic friction?

NAME_____

TEST E (T)

Module M 6 FRICTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 8, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The force of friction is always the same as the externally applied force acting on the sliding object.

T - F 2. The coefficient of friction increases when the force pressing the two surfaces together increases.

T - F 3. The coefficient of rolling friction is usually less than that for sliding friction regardless of the normal force.

T - F 4. Limiting friction is usually greater than kinetic friction if everything else remains the same.

T - F 5. Friction is a phenomenon mankind could well do without. We try to reduce it in every situation in which we find it.

6. The frictional force acting on a car when it is skidding (brakes locked) is 1840 lb. The coefficient of kinetic friction between tires and road is 0.72. What is the weight of the car?

a) 1325 lb c) 2560 lb
b) 4400 lb d) 3200 lb

7. A frictional force on an 3800 lb car, not including air drag is 245 lb. What is the coefficient of kinetic friction?

a) 0.0645 c) 0.155
b) .645 d) 0.0155

8. A 400 lb crate sits on the floor on which the coefficient of limiting friction is 0.45. If the crate has a force of 125 lb acting on it, what is the force of friction?

TEST ANSWER KEYS

Module M 6 FRICTION

PROBLEM	A	B	C	D	E
1	T	T	F	T	F
2	F	F	T	T	F
3	T	T	F	F	T
4	F	T	T	F	T
5	T	F	F	T	F
6	b	a	d	a	d
7	d	c	c	b	a
8	612 lb	475 lb	0.42	0.29	P=137 no,F=169 θr=24.2°

GRADING

NUMBER WRONG	GRADE
0	100
1	88
2	75
3	63
4	50
5	38
6	25

DATA SHEET

Module T 2 HEAT AND CHANGE OF STATE

EXPERIMENT I

Step 2 Diameter of drum _____ m

Mass of drum _____ kg

Step 9 Beginning temperature _____ °C

Step 11 Final temperature _____ °C

Rise in temperature _____ °C

Step 12 Beginning temperature _____ °C

Step 15 Final temperature _____ °C

Rise in temperature _____ °C

Step 16 Weight _____ N

Step 17 Work done _____ J

Step 18 Heat produced _____ kcal

Step 19 Mechanical equivalent of heat _____ J/kcal

Step 20 Error _____ %

CALCULATIONS:

EXPERIMENT II

Step 6 Initial temperature_____°C

Step 9 Voltage_____V

Current_____A

Time_____s

Step 10 Final temperature_____°C

Step 11 Electrical energy supplied_____J

Step 12 Mass_____kg

Step 13 Heat produced_____kcal

Step 14 Electrical equivalent of heat_____J/kcal

Step 15 Error_____%

CALCULATIONS:

NAME_____

TEST A

Module T 2 HEAT AND CHANGE OF STATE

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. The British thermal unit is the amount of heat required to raise the temperature of 1 lb of water 1 F°.

T - F 2. Melting is a heating process because heat is required to raise the temperature.

T - F 3. When a liquid is boiling, turning up the flame will force the liquid to boil at a faster rate but the temperature remains unchanged.

T - F 4. When a substance begins to change state, there are no heat gains or losses until the change is completed.

T - F 5. The machanical equivalent of heat is the ratio of the latent heat of vaporization to the specific heat of a substance.

6. When a liquid vaporizes:

a) Its temperature rises
b) Its temperature drops
c) It emits heat
d) It absorbs heat

7. The specific heat of copper is 0.093 kcal/kg C°. How much heat in kilocalories is required to raise the temperature of a 0.375 kg copper drum from 21°C to 37°C?

a) 0.0349
b) 1.49
c) 0.558
d) 6.00

8. The latent heat of vaporization of gasoline is 135 Btu/lb. How many kilocalories per kilogram is this?

a) 243
b) 75
c) 298
d) 535

9. How much heat is required to raise the temperature of 25 kg of ice from -18°C to 0°C and then melt 5 kg of it? The specific heat of ice is 0.50 kcal/kg C°and the latent heat of fusion is 80 kcal/kg.

OVER

10. Water has a specific heat of 1 Btu/lb F°. How many pounds of propane is required to raise the temperature of 250 lb of water (30 gal water heater) from 40°F to 160°F? The fuel value of propane is 19 100 Btu/lb. Assume all the heat is absorbed by the water.

NAME_____

TEST B

Module T 2 HEAT AND CHANGE OF STATE

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. The calorie is the amount of heat required to raise the temperature of 1 g of water 1 C°.

T - F 2. Freezing is a cooling process because heat must be removed to lower the temperature.

T - F 3. When a liquid is placed in a vacuum, it will boil at a lower temperature.

T - F 4. Whenever a substance can absorb heat, its temperature will always rise.

T - F 5. The mechanical equivalent of heat is the ratio of the work done against friction to the amount of heat produced.

6. When a liquid freezes into a solid:

a) It emits heat
c) It absorbs heat
b) Its temperature rises
d) Its temperature drops

7. The specific heat of iron is 0.11 kcal/kg C°. How much heat is required in kilocalories to raise the temperature of 370 lb V-8 engine from 20°C to operating temperature of 82°C? The weight does not include the coolant or oil. Assume it is all iron.

a) 40.7
c) 22 900
b) 6.8
d) 3144

8. How much heat in British thermal units is required to melt 35 lb of copper if the latent heat of fusion is 77.4 Btu/lb.

a) 2.2
c) 2710
b) 0.45
d) 112

9. How much heat is required to heat 100 lb of lead from 70°F to the melting point (625°F) and then melt it? The specific heat of lead is 0.030 Btu/lb F° and the latent heat of fusion is 6 Btu/lb.

OVER

10. Water has a specific heat of 1 Btu/lb F°. How many gallons of fuel oil is required to raise the temperature of 250 lb of water (30 gal water heater) from 40°F to 160°F? The fuel value of fuel oil is 130 000 Btu/gal. Assume all the heat is absorbed by the water.

NAME_____

TEST C

Module T 2 HEAT AND CHANGE OF STATE

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. The Calorie is the amount of heat required to raise the temperature of 1 kg of a substance one degree.

T - F 2. Freezing is a warming process because heat must be given off to the surroundings thereby warming the surroundings.

T - F 3. When a liquid is placed under pressure, it will boil at a higher temperature.

T - F 4. Whenever a substance can absorb heat, its temperature will rise if there is no change of state.

T - F 5. The mechanical equivalent of heat is the ratio of the Btu to the calorie.

6. When a solid melts into a liquid

a) Its temperature rises c) Its temperature drops

b) It gains heat d) It emits heat

7. The specific heat of lead is 0.030 Btu/lb F°. How much heat in British thermal units is required to raise the temperature of a 28 lb lead weight from 70°F to 625°F?

a) 0.84 c) 15 500

b) 466 d) 16.7

8. How much heat is removed from water vapor and absorbed by the air in a house if 50 lb (6 gal) of water vapor is condensed by an air conditioner in one day? The latent heat of vaporization is 970 Btu/lb.

a) 19.4 c) 4850

b) 5820 d) 48 500

9. How much heat must be removed to lower the temperauture of 25 kg of mercury from 20°C to the freezing point (-40°C) and then freeze it? The specific heat of mercury is 0.033 kcal/kg C° and the latent heat of fusion is 3 kcal/kg.

OVER

10. Water has a specific heat of 1 kcal/kg C°. How many liters of natural gas is necessary to raise the temperautre of 110 kg of water (30 gal water heater) from 5°C to 70°C? The fuel value of natural gas is 10.7 kcal/ℓ. Assume all the heat is absorbed by the water.

NAME _____

TEST D

Module T 2 HEAT AND CHANGE OF STATE

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. The Calorie is the amount of heat required to raise the temperauture of 1 kg of water 1 C°.

T - F 2. Vaporization (boiling) is a cooling process because heat must be drawn from the surroundings thereby cooling the surroundings.

T - F 3. When water is placed under high pressure, it will freeze at a higher temperature.

T - F 4. Ice, water and steam have the same specific heat since they are just different states of the same kind of matter.

T - F 5. The ratio between the heat produced as a result of doing work against friction is called the mechanical equivalent of heat.

6. The freezing point of a liquid is always lower than its

a) melting point c) boiling point

b) specific heat d) heat of fusion

7. Stone has a specific heat of 0.19 Btu/lb F°. How much heat in British thermal units is required to raise the temperature of a 30 000 lb rock bin for a solar heating system from 70°F to 160°F?

a) 513 000 c) 5700

b) 2 700 000 d) 17.1

8. The latent heat of vaporization of gasoline is 75 kcal/kg. About 3.78 kg (1 gal) of gasoline is used every 15 min at 60 mi/h. How much heat in kilocalories does this much gasoline absorb as it vaporizes in the manifolds?

a) 19.8 c) 283

b) 4870 d) 2920

9. How much heat must be removed to lower the temperature of 25 kg of water from 20°C to 0°C and then freeze half of it? The specific heat of water is 1 kcal/kg C° and the latent heat of fusion is 80 kcal/kg.

10. Water has a specific heat of 1 kcal/kg C°. How many liters of fuel oil is required to raise the temperature of 110 kg of water (30 gal water heater) from 5°C to 70°C? The fuel value of fuel oil is 8700 kcal/ℓ. Assume all the heat is absorbed by the water.

NAME_____

TEST E

Module T 2 HEAT AND CHANGE OF STATE

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. The calorie is the amount of heat required to raise the temperature of 1 g of a substance one degree.

T - F 2. Condensation is a cooling process because heat must be given off to lower the temperature.

T - F 3. Almost all materials expand when they change from a liquid to a solid.

T - F 4. Under some circumstances, it is possible to add or remove heat from matter without affecting its temperature.

T - F 5. The ratio between the work done against friction to the resulting heat produced is the mechanical equivalent of heat.

6. The boiling point of a liquid is always higher than its

a) condensation point
b) freezing point
c) heat of vaporization
d) heat of fusion

7. Air has a specific heat of 0.240 kcal/kg C°. How much heat in kilocalories is required to raise the temperature of the air in a small house (585 kg) from 10°C to 20°C?

a) 2.4
b) 5850
c) 1400
d) 140

8. The latent heat of fusion of lead is 6 kcal/kg. How many British thermal units per pound is this?

a) 0.25
b) 13.2
c) 23.7
d) 10.8

9. How much heat is required to raise the temperature of 10 lb of ice from 0°F to 32°F, melt it and then raise the temperature of the resulting water from 32°F to 70°F. The specific heat of ice and water is 0.5 Btu/lb F° and 1 Btu/lb F°, respectively. The latent heat of fusion is 144 Btu/lb.

OVER

10. Water has a specific heat of 1 kcal/kg C°. How many kilograms of propane is required to raise the temperature of 110 kg of water (30 gal water heater) from 5°C to 70°C? The fuel value of propane is 10 600 kcal/kg. Assume all the heat is absorbed by the water.

TEST ANSWER KEYS

Module T 2 HEAT AND CHANGE OF STATE

PROBLEM	A	B	C	D	E
1	T	T	F	T	F
2	F	F	T	T	F
3	T	T	T	F	F
4	F	F	T	F	T
5	F	T	F	F	T
6	c	a	b	c	b
7	c	d	b	a	c
8	b	c	d	c	d
9	625 kcal	2265 Btu	124 kcal	1500 kcal	1980 Btu
10	0.23 gal	1.57 lb	668 ℓ	0.82 ℓ	0.66 kg

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

DATA SHEET

Module W 4 EXPERIMENT I

Steps 1-5

Plastic surface	R(m)	Length (m)	width (m)	area (m^2)	solid angle (sr)
1					
2					
3					
10					

Step 6

Step 7

Step 8

Step 9

Surface	Illumination (E = F/A)	Illumination ($E = I/R^2$)
1		
2		
3		
10		

Step 10

Step 11

DATA SHEET

Module W 4 EXPERIMENT II

Step 1 S_____ u_____

Step 2 I_s_____cd

Step 6-7

trial	location
1	
2	
3	
4	
5	
6	
average	

Step 8 R_s_____m R_u_____m

Step 9 I_u_____cd

Step 14

trial	location
1	
2	
3	
4	
5	
6	
average	

R_s_____m R_u_____m

I_u_____cd

Step 15

NAME_____

TEST A

Module W 4 ILLUMINATION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 12 circle your final answer. Be sure to include your name in the space provided.

A	$\omega = A/R^2$	E	Solid angle
B	Illumination	F	Light meter
C	Incandescent	G	Standard source
D	Translucent	H	Output (lm)/input (W)

Match each of the following statements with the terms listed above. NOTE: Some may be used twice; some not at all.

_____1. Transmitts diffuse light

_____2. Defines a quantity having steradians as its units

_____3. Defines the candela

_____4. Has units of lumins per square foot

_____5. Defines luminous efficiency

_____6. Luminous body

_____7. Has units of steradians

_____8. Measures illumination

9. Which of the following is <u>not</u> a unit of illumination?

a) lux
b) lumins per square foot
c) lumin
d) lumin per square meter

10. A solid angle subtends a surface of 7.5 m^2 at a radius of 3m. The solid angle is:

a) 2.5 sr
b) 0.40 sr
c) 0.833 sr
d) 1.20 sr

11. A point source has an intensity of 75 cd. What is the total luminous flux emitted by this source if it is emitted uniformly in all directions?

a) 94.2 lm
b) 5.97 lm
c) 471 lm
d) 942 lm

12. At a distance of 0.65 m from a desk lamp, the illumination is the same as that received from a 900 cd ceiling lamp at a distance of 1.95 m. What is the intensity of the desk lamp?

NAME_____

TEST B

Module W 4 ILLUMINATION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 12 circle your final answer. Be sure to include your name in the space provided.

A	Foot candle meter	E	Opaque
B	E = F/A	F	Luminous flux
C	I = F/ω	G	Photometer
D	Illumination	H	Fluorescent

Match each of the following statements with the terms listed above. NOTE: Some may be used twice; some not at all.

_____1. Defines luminous intensity

_____2. Has units of luxes

_____3. Luminous body

_____4. Another name for visible radiation power

_____5. Defines illuminance

_____6. Will not transmit light

_____7. Compares luminous intensity of two light sources

_____8. Measures illumination

9. Which of the following is a unit of luminous flux?

a) lumin
b) lumin per square meter
c) lumin per watt
d) lumin per steradian

10. A luminous flux of 1150 lm is incident on a table having 3 m^2 of surface area. The illumination is:

a) 128 lx
b) 383 lx
c) 400 lx
d) 1000 lx

11. The illumination of a floor is 150 lx. It is 3 m from a point source. What is the luminous intensity of the source?

a) 50 cd
b) 1350 cd
c) 450 cd
d) 16.7 cd

12. A reflector uniformly concentrates all the light from a bulb in a solid angle of 0.25 sr. The luminous flux in the direction of the beam is 1500 lm. What is the illumination at a distance of 2 m from the bulb?

NAME _____

TEST C

Module W 4 ILLUMINATION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 12 circle your final answer. Be sure to include your name in the space provided.

A	Luminous effieciency	E	Luminous intensity
B	$I = F/\omega$	F	Standard source
C	Photometer	G	Transparent
D	Luminous body	H	$E = I/R^2$

Match each of the following statements with the terms listed above. NOTE: Some may be used twice; some not at all.

_____1. Visible without other source of light

_____2. Has units of lumin per steradian

_____3. Output (lm)/ input (W)

_____4. Defines the unit of luminous intensity

_____5. Defines luminous intensity

_____6. Relates illumination and luminous intensity

_____7. Transmits light

_____8. Compares luminous intensity

9. Which of the following is <u>not</u> a unit of illumination?

a) foot candle
b) lux
c) lumin per square meter
d) lumin per steradian

10. What is the illumination of a table 2.5 m from a source having a luminous intensity of 1000 cd?

a) 160 lx
b) 16 lx
c) 400 lx
d) 1000 lx

11. A table having 3.5 m^2 of surface has a uniform illumination of 460 lx. What is the total luminous flux incident on the table?

a) 131 lm
b) 37.6 lm
c) 1610 lm
d) 5640 lm

12. A 100 W bulb has all its light concentrated by a reflector into a solid angle beam of 1.7 sr. If the luminous intensity of the bulb is 75 cd what is the luminous efficiency of the bulb? Assume the bulb is a point source.

NAME_____

TEST D

Module W 4 ILLUMINATION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 12 circle your final answer. Be sure to include your name in the space provided.

A	Luminous intensity	E	Opaque
B	$\omega = A/R^2$	F	Standard source
C	Footcandle meter	G	Solid angle
D	Illuminated	H	$E = I/R^2$

Match each of the following statements with the terms listed above. NOTE: Some may be used twice; some not at all.

_____1. Has units of candelas

_____2. Has units of steradians

_____3. Reflects light

_____4. Defines the candela

_____5. Inverse square law

_____6. Defines solid angle

_____7. Measures illumination

_____8. Doesn't transmit light

9. Which of the following is <u>not</u> a unit of illumination:

a) foot candle
b) lm/sr
c) lx
d) lm/m^2

10. A point source emits 400 lm of luminous flux uniformly in all directions. Its luminous intensity is:

a) 5030 cd
b) 31.8 cd
c) 63.7 cd
d) 127 cd

11. A solid angle of 0.40 sr has a source of light at its vertex and subtends a certain surface at a distance of 3.5 m. What is the area of the surface?

a) $4.9\ m^2$
b) $0.327\ m^2$
c) $1.4\ m^2$
d) $0.114\ m^2$

12. A 175 cd lamp is 2 m above a table. At what distance above the table would this lamp provide 50% more illumination?

NAME _____

TEST E

Module W 4 ILLUMINATION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 12 circle your final answer. Be sure to include your name in the space provided.

A	Illumination	E	Light meter
B	Incandescent	F	$I = F/\omega$
C	$E = F/A$	G	Photometer
D	Luminous flux	H	Translucent

Match each of the following statements with the terms listed above. NOTE: Some may be used twice; some not at all.

_____1. Compare luminous intensity

_____2. Has units of lumins

_____3. Defines illumination

_____4. Transmits scattered light

_____5. Measures illimination

_____6. Has units of lumins per square meter

_____7. Self-luminous

_____8. Defines luminous intensity

9. Which of the following formulas defines illumination?

a) $E = F/A$
b) $E = F/\omega$
c) $A = \omega R^2$
d) $E = I/R^2$

10. A tungsten lamp has a luminous efficiency of 16 lm/W. If its luminous output is 1600 lm, what is the power input in watts?

a) 25 600
b) 1600
c) 0.01
d) 100

11. A source of light emits 75 lm of luminous flux in a solid angle of 1.2 sr. What is the intensity of the source?

a) 90 cd
b) 108 cd
c) 62.5 cd
d) 0.016 cd

12. A standard lamp rated at 34 cd is placed 35 cm from a photometer screen. An unknown lamp is 90 cm from the screen when the two lamps provide equal illumination on the screen. What is the luminous intensity of the unknown?

TEST ANSWER KEYS

Module W 4 ILLUMINATION

PROBLEM	A	B	C	D	E
1	D	C	D	A	G
2	A	D	E	G	D
3	G	H	A	D	C
4	B	F	F	F	H
5	H	B	B	H	E
6	C	E	H	B	A
7	E	G	G	C	B
8	F	A	C	E	F
9	c	a	d	b	a
10	c	b	a	b	d
11	d	b	c	a	c
12	100 cd	1500 lx	9.4 lm/W	1.63 m	225 cd

GRADING

NUMBER WRONG	GRADE
0	100
1	92
2	84
3	75
4	67
5	58
6	50

DATA SHEET

Module W 2 INTERFERENCE OF WAVES

EXPERIMENT A

Steps 5 - 8

mass location	number of beats	time	beat period	beat frequency
1 in				
2 in				
3 in				
4 in				
5 in				
6 in				
7 in				
8 in				
9 in				
10 in				

Step 10 1st vibrator_____Hz

2nd vibrator_____Hz

Step 11 Beat frequency _____

Step 12 Frequency difference_____

Step 13 Comparison_____

Calculations:

Step 16 Number of interference fringes passing the reference mark.

Trial	N
1	
2	
3	
4	
5	
Average	

Step 17 Length of vacuum chamber

Trial	d
top	
front	
bottom	
Average	

Step 18 Color of filter used_____

Wavelength _____

Index of refraction_____

Step 19 Comparison_____

Step 20 Question:

Calculations:

NAME_____

TEST A

Module W 2 INTERFERENCE OF WAVES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Be sure to include your name in the space provided.

T - F 1. Interference can occur in longitudinal waves only.

T - F 2. The principle of superposition states that the displacement of a point is the resultant of the displacements which would be produced by each of two or more waves if they acted separately.

T - F 3. Light reflected by the surface of an optically more dense medium will not undergo a 180° phase shift.

T - F 4. The points that do not remain stationary in a standing wave are called nodes.

T - F 5. In various kinds of interference, bright lines, antinodes and intensity maxima are the result of constructive interference.

6. Two tuning forks of frequencies 3100 Hz and 3120 Hz vibrate, simultaneously. The beat frequency is

a) 0 c) 20

b) 1315 d) 2630

7. A standing current wave is created in a transmission line by a short circuit at the end of the line. A current antinode exists at the end. The first node is 1000 km back toward the generator. The wavelength is:

a) 4000 km c) 2000 km

b) 3000 km d) 1000 km

8. Two waves meet at a point and time where one has an instantaneous displacement of 8 cm and the other -3 cm. The resultant displacement of the point is:

a) -3 cm c) 5 cm

b) 8 cm d) 13 cm

OVER

9. Monochromatic green light of wavelength 500 nm illuminates a pair of narrow slits 0.2 mm apart. The separation of bright lines on the interference pattern 8 m away is:

a) 0.2 mm
c) 4 mm
b) 2 mm
d) 20 mm

10. An observer looks at a source through a grating having 10 000 slits/cm. If the wavelength is 4000 angstroms, at what angle will the 2nd order image be seen?

a) 53.1°
c) 27.6°
b) 84.3°
d) 3.45°

NAME_____

TEST B

Module W 2 INTERFERENCE OF WAVES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Be sure to include your name in the space provided.

T - F 1. Interference can occur in either transverse or longitudinal waves.

T - F 2. The principle of superposition states the relationship between the amplitude and frequency of a given wave.

T - F 3. Light reflected by the surface of an optically less dense medium will not undergo a 180° phase shift.

T - F 4. The points that remain stationary in a standing wave are called nodes.

T - F 5. Interference occurs only when two waves arrive at the same point out of phase with each other.

6. Beats are the result of:

a) Diffraction
b) Resonance
c) Huygen's principle
d) Interference

7. A standing voltage wave is created in a transmission line by an open circuit at the end of the line. A voltage antinode exists at the end. The first node is 900 km back toward the generator. The wavelength is:

a) 2700 km
b) 3600 km
c) 900 km
d) 1800 km

8. Two waves meet at a point and time where one has an instantaneous displacement of -5 cm and the other -7 cm. The resultant displacement of the point is:

a) -12 cm
b) -2 cm
c) -5 cm
d) -7 cm

OVER

9. Monochromatic green light of wavelength 5000 A° illuminates a pair of narrow slits 0.1 cm apart. The separation of bright lines on the interference pattern formed on a screen 4 m away is:

a) 2.0 mm

b) 0.8 mm

c) 0.2 mm

d) 0.5 mm

10. An air wedge is formed by placing a thin blond hair between the edges of two plane glass plates which are in contact at the other end. When viewed by reflective light of wavelength 5000 A, 78 dark bands are observed including the ones at both ends. The diameter of the hair is:

a) 3.85×10^{-2} mm

b) 1.93×10^{-2} mm

c) 7.70×10^{-2} mm

d) 5.39×10^{-2} mm

NAME_____

TEST C

Module W 2 INTERFERENCE OF WAVES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Be sure to include your name in the space provided.

T - F 1. Interference can occur in electromagnetic waves but not mechanical waves.

T - F 2. The principle of superposition states the relationship between the the velocity, wavelength and frequency of a given wave.

T - F 3. Light reflected by the surface of an optically less dense medium will undergo a one-half wavelength phase shift.

T - F 4. The points that do not remain stationary in a standing wave are called antinodes.

T - F 5. Constructive interference occurs when two waves arrive at the same point in phase with each other.

6. Beats are produced by the increase and decrease of the:

a) Frequency c) Period

b) Amplitude d) Velocity

7. Wind causes a transmission line to vibrate, setting up standing waves. Nodes exist at the insulators on the poles and two nodes, also, exist between the poles. What is the wavelength if the distance between poles is 60 m?

a) 60 m c) 40 m

b) 20 m d) 30 m

8. Two waves meet at a point and time where one has an instantaneous displacement of -9 cm and the other 4 cm. The resultant displacement of this point is:

a) 5 cm c) 13 cm

b) -13 cm d) -5 cm

OVER

9. When a Michelson's interferometer was used to measure the wavelength of monochromatic light, it was found that 300 bright fringes passed the reference mark when the moveable mirror was displaced 0.066 mm. The wavelength of light was:

a) 440 nm
c) 880 nm
b) 220 nm
d) 110 nm

10. An observer looks at a source through a grating having 1000 slits/cm. If λ = 600 nm, at what angle will the 2nd order image be seen?

a) 13.8°
c) 6.9°
b) 27.6°
d) 3.45°

NAME _____

TEST D

Module W 2 INTERFERENCE OF WAVES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Be sure to include your name in the space provided.

T - F 1. Interference can occur in both electromagnetic and mechanical waves.

T - F 2. The principle of superposition applies to all kinds of waves (longitudinal and transverse).

T - F 3. If light traveling in water (n = 1.33) is reflected from a glass surface (n = 1.52), there will not be a 180° phase shift.

T - F 4. Coherent light sources are those in which there is no regular phase relation between the waves.

T - F 5. Nodes are the result of constructive interference while antinodes are the result of destructive interference.

6. One tuning fork has a frequency of 560 Hz. If 8 beats are heard each second, the other tuning fork has a frequency of

a) 552 Hz or 568 Hz
c) 560 Hz
b) 556 Hz or 564 Hz
d) 3 Hz

7. A vertical antenna pole vibrates in the wind setting up standing waves. A node exists at the ground and an antinode at the top (free) end. One additional node exists between top and bottom. If the pole is 9 m high, what is the wavelength?

a) 6 m
c) 12 m
b) 9 m
d) 18 m

8. Two waves meet at a point and time where one has an instantaneous displacement of -8 cm and the other +8 cm. The resultant displacement of the point is:

a) -16 cm
c) 16 cm
b) 0 cm
d) 8 cm

OVER

9. When a Michelson's interferometer was used to measure the wavelength of monochromatic light, it was found that 150 fringes passed by the reference mark when the movable mirror was displaced 0.033 mm. The wavelength of light was:

a) 1100 A° c) 2200 A°

b) 4400 A° d) 8800 A°

10. An air wedge is formed by placing a hair between the edges of two plane glass plates which are in contact at the other end. When viewed by reflected light of wavelength 6000 A°, 78 dark bands are observe including the ones at both ends. The diameter of the hair is:

a) 2.31×10^{-2} mm c) 7.49×10^{-2} mm

b) 4.62×10^{-2} mm d) 9.24×10^{-2} mm

NAME_____

TEST E

Module W 2 INTERFERENCE OF WAVES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Be sure to include your name in the space provided.

T - F 1. Interference can occur in either transverse or longitudinal waves and either electromagnetic or mechanical waves.

T - F 2. The principle of superposition describes the condition in which a wave undergoes a 180° phase shift during reflection.

T - F 3. If light traveling in plastic (n = 1.41) is reflected from a water surface (n = 1.33), there will not be a 180° change of phase.

T - F 4. Coherent light sources are those in which there is a regular phase relation between the waves.

T - F 5. In an interference pattern (light), the bright lines are due to destructive interference.

6. Ten beats are produced each second. One tuning fork has a frequency of 880 Hz. The other has a frequency of:

a) Either 875 Hz or 885 Hz
b) Either 870 Hz or 890 Hz
c) Either 1750 Hz or 1770 Hz
d) Between 0 Hz and 10 Hz

7. A standing voltage wave is created in a transmission line by a short circuit at the end of the line. A voltage node exists at the end. The first antinode is 900 km back toward the generator. The wavelength is:

a) 3600 km
b) 2700 km
c) 1800 km
d) 900 km

8. Two waves meet at a point and time where one has an instantaneous displacement of 2 cm and other 2 cm. The resultant displacement of the point is:

a) 4 cm
b) 0 cm
c) 2 cm
d) -4 cm

OVER

9. When a Michelson's interferometer was used to measure the wavelength of monochromatic light, it was found that bright fringes passed the reference mark when the moveable mirror was displaced 0.0066 cm. The wavelength of light was:

a) 183 nm
c) 733 nm
b) 1467 nm
d) 367 nm

10. An observer looks at a source through a grating having 1000 slits/cm. If λ = 5000 A°, at what angle will the 3rd order image be seen?

a) 34.52°
c) 4.32°
b) 17.26°
d) 8.63°

TEST ANSWER KEYS

Module W 2 INTERFERENCE OF WAVES

PROBLEM	A	B	C	D	E
1	F	T	F	T	T
2	T	F	F	T	F
3	F	T	F	F	T
4	F	T	T	F	T
5	T	F	T	F	F
6	c	d	b	a	b
7	a	b	c	c	a
8	c	a	d	b	a
9	d	a	a	b	c
10	a	b	c	a	d

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

DATA SHEET

Module M 7 THE LAWS OF MOTION

EXPERIMENT 1

FIRST SPARK RECORD

t	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
s												
V_{av}												

t	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
s												
V_{av}												

TABLE:

Interval	a
1, 2	
2, 3	
3, 4	
4, 5	
5, 6	

Interval	a
6, 7	
7, 8	
8, 9	
9, 10	
10, 11	

Interval	a
11, 12	
12, 13	
13, 14	
14, 15	
15, 16	

Calculations

a average=_____

SECOND SPARK RECORD

t	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
s												
V_{av}												

t	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
s												
V_{av}												

TABLE:

Interval	a
1, 2	
2, 3	
3, 4	
4, 5	
5, 6	

Interval	a
6, 7	
7, 8	
8, 9	
9, 10	
10, 11	

Interval	a
11, 12	
12, 13	
13, 14	
14, 15	
15, 16	

Calculations

a average=_____

THIRD SPARK SOURCE

t	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
s												
Vav												

t	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
s												
Vav												

TABLE:

Interval	a
1, 2	
2, 3	
3, 4	
4, 5	
5, 6	

Interval	a
6, 7	
7, 8	
8, 9	
9, 10	
10, 11	

Interval	a
11, 12	
12, 13	
13, 14	
14, 15	
15, 16	

Calculations

a average=_____

STEP 31

Mass of small glider_____
Mass of large glider_____
Mass ratio_____
Acceleration ratio (inverse)_____
Comparison_____ %

STEP 32

Force ratio_____
Acceleration ratio_____
Comparison_____ %

DATA SHEET

Module M 7 THE LAWS OF MOTION

EXPERIMENT 2

mass	time (50 cycle)	Frequency	Period	Period squared
100 g				
200 g				
300 g				
400 g				
500 g				
600 g				
Unknown				
Unknown suspended				

Step 12 _____ Mass of unknown (resting on pan)

Step 15 _____ Mass of unknown (suspended)

Step 16 _____ Mass of unknown (Harvard balance)

Step 17 _____ % Percentage difference

QUESTIONS

See Step 9

See Step 15

Graph paper on reverse.

NAME_____

TEST A

Module M 7 THE LAWS OF MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The inertia of a moving object doesn't depend on its velocity.

T - F 2. Action and reaction forces always cancel because they are equal in magnitude but opposite in direction.

T - F 3. The pound is the unit of mass in the British measuring system.

T - F 4. The slug may be expressed as $lb \cdot s^2/ft$ in British fundamental units. ($F = ma$)

T - F 5. A net force of 50 lb acting on a 25 slug mass will accelerate at 4 ft/s^2.

6. The mass of a one cylinder engine is 32 kg. Its weight in newtons is:

a) 1 c) 3.27
b) 1024 d) 314

7. A certain net force gives a 48 kg lead ball an acceleration of 3 m/s^2. The same net force would give a 24 kg ball and acceleration in m/s^2 of:

a) 1 c) 6
b) 12 d) 144

8. When an object has a net force on it, you know for sure that:

a) Its inertia changes c) Its acceleration is positive
b) Its velocity changes d) Its acceleration is negative

9. A 1900 kg automobile is traveling 80 km/hr. How much distance will it take to come to a stop if a braking force of 4200 N is applied?

10. A 105 lb TV set rests on a cart. What is the maximum acceleration you can give the cart without making the TV set slide on the table? The coefficient of limiting friction is 0.5.

NAME_____

TEST B

Module M 7 THE LAWS OF MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Inertia is the resistance to changes in state of motion and doesn't depend on the motion itself.

T - F 2. Action and reaction forces cannot cancel because they don't act on the same object.

T - F 3. The newton is the unit of mass in the MKS (SI) measuring system.

T - F 4. The newton may be expressed as $kg \cdot m/s^2$ in MKS fundamental units. ($F = ma$)

T - F 5. A net force of 20 N acting on a 5 kg mass will accelerate at 0.25 m/s^2.

6. The mass of an automobile is 120 slug. Its weight in pounds is:

a) 3200 c) 2850
b) 3840 d) 1180

7. A force of 10 lb gives a lead ball an acceleration of 5 ft/s^2. A force of 25 lb would give the same ball an acceleration in ft/s^2 of:

a) 2 c) 50
b) 12.5 d) 32

8. When an object has a negative net force on it, you know for sure that:

a) Its inertia decreases
b) Its displacement is negative
c) Its velocity is negative
d) Its acceleration is negative

9. How much time does it take to stop a 3600 lb automobile traveling 45 mi/h if a braking force of 875 lb is applied?

10. An elevator with its load has a mass of 2000 kg. What is the maximum upward acceleration it can have if the supporting cables can safely support no more than 30 000 N?

NAME _____

TEST C

Module M 7 THE LAWS OF MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The inertia of an object at rest is less than its inertia when it is moving.

T - F 2. If there is an external force on an object, there must be another object somewhere that exerts the force on the first object.

T - F 3. The slug is the unit of mass in the British measuring system.

T - F 4. The newton may be expressed as $kg \cdot s^2/m$ in MKS fundamental units. ($F = ma$)

T - F 5. A net force of 5 N acting on a 20 kg mass will accelerate at 0.25 m/s^2.

6. The mass of a pocket calculator is 255 g. Its weight in newtons is:

a) 2.50 c) 0.0080
b) 0.026 d) 8.2

7. A force of 10 N acting on a lead ball gives it an acceleration of 4 m/s^2. What force in newtons is necessary to give the same ball and acceleration of 9.8 m/s^2?

a) 40 c) 2.5
b) 24.5 d) 32

8. If the mass of an object remains the same, the ratio of net force to acceleration will:

a) be negative c) increase
b) decrease d) remain the same

9. How much time does it take to stop a 1900 kg automobile traveling 80 km/hr if a braking force of 3800 N is applied?

10. A derrick lifts a load of 4 ton with cables that can support 5 tons of tension without breaking. What is the maximum acceleration the load can be given?

NAME_____

TEST D

Module M 7 THE LAWS OF MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Doubling the speed of an automobile doubles its inertia.

T - F 2. If object A exerts a force on object B, then object B exerts an equal and opposite force on object A.

T - F 3. The kilogram is the unit of weight in the MKS (SI) measuring system.

T - F 4. The dyne may be expressed as g cm/s^2 in cgs fundamental units.

T - F 5. A net force of 25 N causes an object to accelerate at 5 m/s^2. The mass of the object is 0.2 kg.

6. A force of 300 dynes gives a 150 g lead ball a certain acceleration. What is the mass in grams of a second ball if 2500 dynes of force gives it the same acceleration?

a) 0.5 c) 5000
b) 2 d) 1250

7. When an object has a positive net force acting on it, you can be sure that:

a) Its acceleration is positive
b) Its velocity is positive
c) Its displacement is positive
d) Its inertia will increase

8. The weight of a volt-ohm meter is 9.5 N. Its mass in kilograms is:

a) 0.30 c) 304
b) 93 d) 0.97

9. A 3600 lb automobile is going 45 mi/h. What is the braking force on it if it can come to a stop in 300 ft?

10. An 85 lb molding rests on a shop cart. What is the maximum acceleration you can give the cart without causing the molding to slide on the table? The coefficient of limiting friction is 0.7.

NAME_____

TEST E

Module M 7 THE LAWS OF MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. A body at rest has as much inertia as the same body in motion, whatever the speed.

T - F 2. Action-reaction pairs of forces are just like resultant-equilibrant pairs; they always cancel each other.

T - F 3. The newton is the unit of weight in the MKS (SI) measuring system.

T - F 4. The dyne may be expressed as $g \cdot s^2/m$ in fundamental cgs units.

T - F 5. A net force of 25 N causes an object to accelerate at 5 m/s^2. The mass of the object is 5 kg.

6. The weight of a large torque wrench is 25 N. Its mass in kilograms is:

a) 0.78 c) 2.55
b) 245 d) 800

7. A force of 80 N gives a 1.5 kg lead ball a certain acceleration. What force in newtons would give an 8.7 kg ball the same acceleration?

a) 120 c) 464
b) 696 d) 13.8

8. When an object has a positive acceleration, you can be sure that:

a) Its net force is positive c) Its displacement is positive
b) Its velocity is positive d) Its inertia increases

9. A 1900 kg automobile is going 80 km/h. What is the braking force on it if it can come to a stop in 80 m?

10. A derrick lifts a load of 3000 kg with cables that can support 35 000 N of tension without breaking. What is the maximum acceleration the load can be given?

TEST ANSWER KEYS

Module M 7 THE LAWS OF MOTION

PROBLEM	A	B	C	D	E
1	T	T	F	F	T
2	F	T	T	T	F
3	F	F	T	F	T
4	T	T	F	T	F
5	F	F	T	F	T
6	d	b	a	d	c
7	c	b	b	a	c
8	b	d	d	d	a
9	112 m	8.5 s	11.1 s	817 lb	5860 N
10	16 ft/s^2	5.2 m/s^2	8 ft/s^2	22.4 ft/s^2	1.87 m/s^2

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

DATA SHEET

Module P 1 MECHANICAL PROPERTIES OF MATTER

Steps 1 - 6

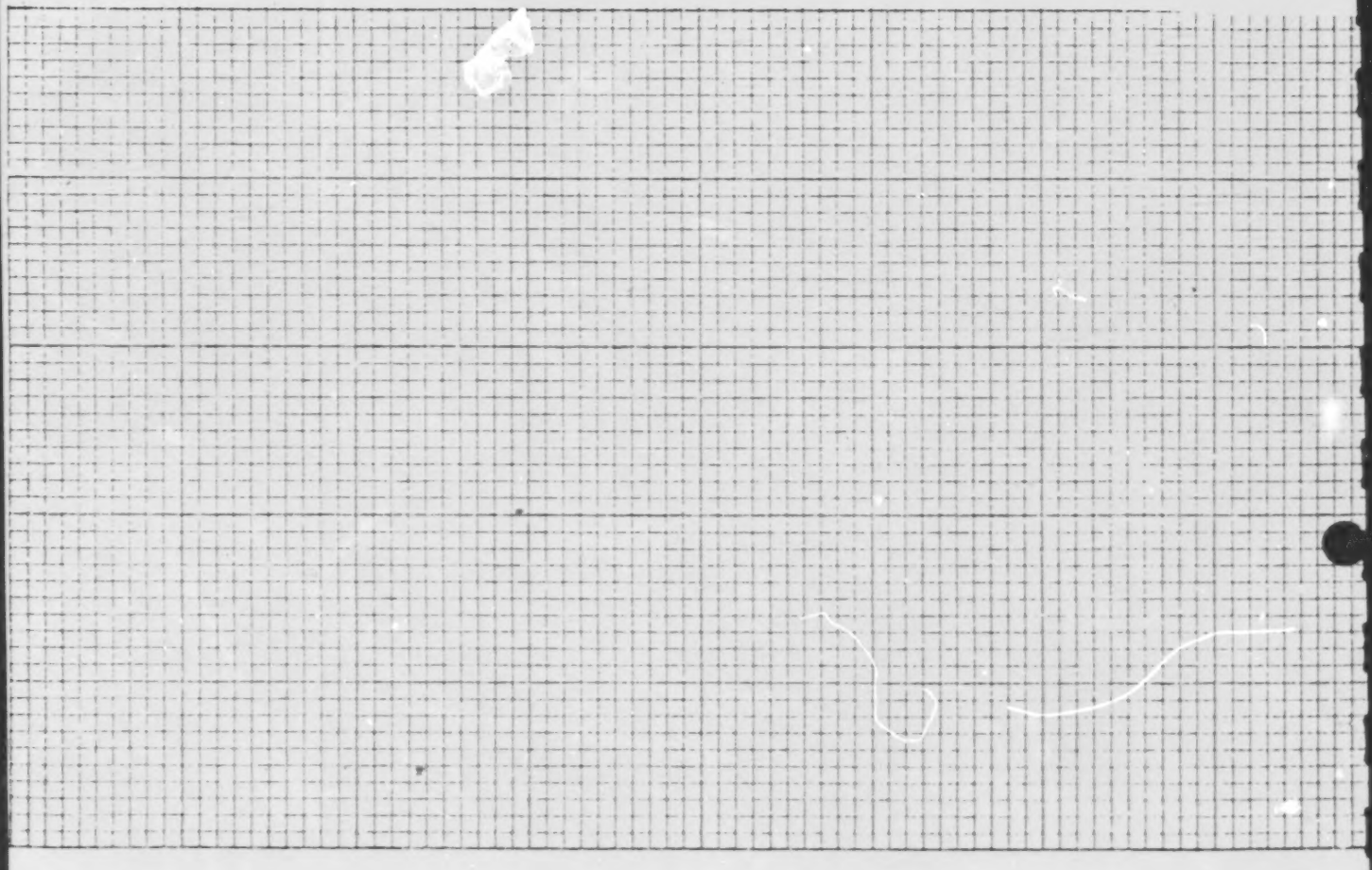
Mass on hanger (g)	Weight on hanger (dyne)	Pointer position (cm)	Difference in successive readings (cm)
0			
50			
100			
150			
200			
250			
200			
150			
100			
50			
0			
			average

Step 8

Step 10 _____ cm

Step 11 _____ dynes/cm

Steps 7



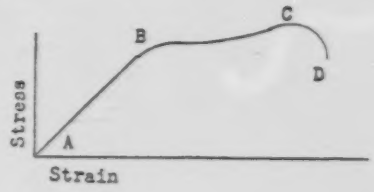
NAME_____

TEST A

Module P 1 MECHANICAL PROPERTIES OF MATTER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. The figure represents the stress-strain curve for a certain metal. Point B represents the ultimate strength of the metal.



T - F 2. The mass density of a substance is the same at sea level as it is on top of a mountain.

T - F 3. Tensile stresses cause an increase in the length of an object.

T - F 4. If the ultimate strength is not exceeded then stress is proportional to strain.

T - F 5. If material A will scratch material B (at slow speed), then material B is said to be harder than material A.

6. Mercury has a weight density of 849 lb/ft^3. If a container of mercury has a volume of 0.25 ft^3, its weight in pounds is:

a) 0.000294 c) 212 lb

b) 3396 d) 0.294

7. When a strain of 0.00611 occurs in a brass rod, what is the applied stress in pounds per square inch? ($Y = 9 \times 10^6$ lb/in^2).

a) 1.47×10^9 c) 61 100

b) 55 000 d) 9000

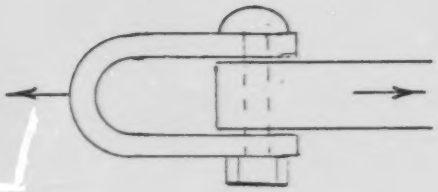
8. A force of 7500 lb creates a stress of 9500 lb/in^2 in a rod. What is the rod's cross-sectional area in square inches?

a) 1.27 c) 0.79

b) 0.42 d) 3.82

OVER

9.



A clevis is a U-shaped piece of iron with holes in the ends through which a pin runs to attach one thing to another. What force is required to shear the pin if it has a 1 in diameter? The ultimate strength of the steel pin is 30 000 lb/in^2. Note that it will shear in two places (see diagram).

10. A wooden post 8 ft long has a cross section of 7 in by 9 in. If a load shortens it by 0.025 in, what is the load in pounds? (Y = 1 600 000 lb/in^2).

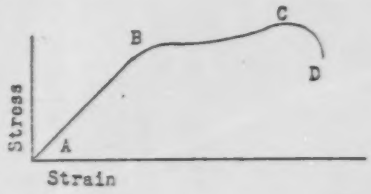
NAME_____

TEST B

Module P 1 MECHANICAL PROPERTIES OF MATTER

Read each question carefully and decide which one of the answers is best. Notice what letter choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. The figure represents the stress-strain curve for a certain metal. Elastic deformations occur only in the section from point B to D.



T - F 2. The units of weight density in the British measuring system is lb/ft^3.

T - F 3. Tensile and bulk stresses tend to cause the same kind of deformation.

T - F 4. Hooke's law states that stress is proportional to strain under all circumstances.

T - F 5. A malleable substance is one that is capable of being hammered or rolled into thin sheets.

6. If an aluminum object has a mass of 3.7 kg and a density of 2.7 g/cm^3, its volume in cubic centimeters is :

a) 1370 c) 10 000

b) 10 d) 730

7. A stress of 2×10^8 N/m^2 creates a strain of 0.0116. What is the modulus of elasticity in newtons per square meter?

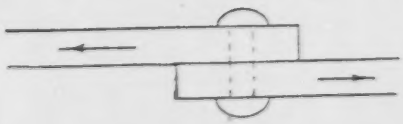
a) 2.32×10^5 c) 1.72×10^{10}

b) 1.72×10^5 d) 5.8×10^{-12}

8. What is the stress created by a 500 lb force applied to an area of 0.025 in^2. (Give answer in pounds per square inch).

a) 2 c) 0.00005

b) 12.5 d) 20 000

9. 

What force is required to shear the 0.5 in rivet if it has an ultimate strength of 29 000 lb/in^2? (see diagram)

OVER

10. A 60 ft cable with a 1 in diameter lifts a load of 2000 lb. How much will its length increase if it is made of steel? ($Y = 29\ 000\ 000\ lb/in^2$).

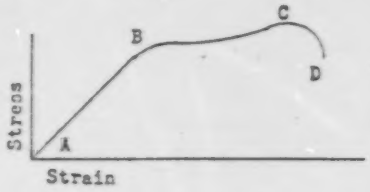
NAME_____

TEST C

Module P 1 MECHANICAL PROPERTIES OF MATTER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 6,7 and 8 circle your final answer. Be sure to include your name in the space provided.

T - F 1. The figure represents the stress-strain curve for a certain metal. Point C represents the ultimate strength of the material.



T - F 2. The units of mass density in the MKS measuring system is kg/m^3.

T - F 3. The elastic limit of a substance is always greater than the ultimate strength.

T - F 4. The tensile (Young's) modulus of elasticity has the same numerical value as the shear modulus for a given substance.

T - F 5. A ductile substance is one that is capable of being drawn into wires.

6. Brass has a mass density of 16.9 $slug/ft^3$, what is its weight density:

a) 540 kg/m^3 c) 0.53 g/cm^3

b) 540 lb/ft^3 d) 1.89 lb/ft^3

7. When a stress of 40 000 lb/in^2 is applied to steel rod, what is the strain? ($Y = 3 \times 10^7$ lb/in^2).

a) 10×10^{11} c) 0.625

b) 625 d) 0.00133

8. What change in length of a 40 ft cable occurs if the strain is 0.00725?

a) 3.48 in c) 5.52 in

b) 0.29 in d) 1.04 in

9. Two 1 in steel cables support an elevator. How much is the normal load they support if the factor of safety is 3.2 and the ultimate tensile stress is 60 000 lb/in^2.

OVER

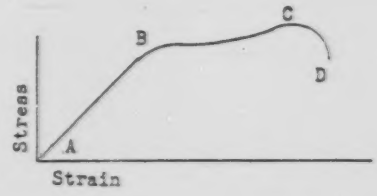
10. The bulk modulus of hydraulic oil is 7.4×10^5 lb/in^2. A certain hydraulic jack contains 30 in^3 of the oil. If the oil is subjected to bulk stress (pressure) of 5000 lb/in^2 what decrease in volume will there be?

NAME _____

TEST D

Module P 1 MECHANICAL PROPERTIES OF MATTER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.



T - F 1. The figure represents the stress-strain curve for a certain metal. Elastic deformations occur only in the section from point A to B.

T - F 2. The units of mass density in the British measuring system in lb/ft^3.

T - F 3. The ultimate strength of a substance is proportional to the elastic limit.

T - F 4. The elastic limit stress is the greatest stress a material can be subjected to without breaking.

T - F 5. If material A will scratch material B (at slow speeds), then material A is said to be harder than material B.

6. Lead has a density of 11.4 g/cm^3. What is it in pounds per cubic foot?

a) 364 c) 712

b) 112 d) 568

7. A stress of 90 000 lb/in^2 creates a strain of 0.00346 in an iron rod. What is the modulus of elasticity for iron in pounds per square inch?

a) 26 000 000 c) 3.8×10^{-8}

b) 311 d) 38 000 000

8. What is the original length of a cable if a strain of 0.00185 increases the length by 1 in?

a) 0.022 ft c) 45 ft

b) 540 ft d) 108 ft

9. A 1 in steel cable was designed with a factor of safety of 3. What is the normal load for this cable if the ultimate tensile stress is 60 000 lb/in^2?

OVER

10. The bulk modulus of hydraulic oil is 7.4×10^5 lb/in^2. What bulk stress (pressure) is required to decrease the volume of 1155 in^3 (5 gal) by 11.55 in^3 (1%)?

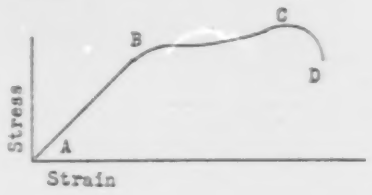
NAME _____

TEST E

Module P 1 MECHANICAL PROPERTIES OF MATTER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. The figure represents the stress-strain curve for a certain metal. Point B represents the elastic limit of the metal.



T - F 2. The units of weight density in the MKS measuring system is kg/m^3.

T - F 3. Bulk stresses tend to decrease the volume of a substance.

T - F 4. The ultimate strength is the greatest stress a material can be subjected to without breaking.

T - F 5. A highly malleable material is always a highly ductile material.

6. Steel has a density of 489 lb/ft^3. Its density in grams per cubic centimeters is:

a) 7.84 c) 2.00

b) 15.3 d) 4790

7. When a strain of 0.00334 occurs in a steel rod, what is the applied stress in newtons per square meter? ($Y = 20 \times 10^{10} N/m$).

a) 5.99×10^7 c) 6.68×10^8

b) 5.99×10^{13} d) 3.24×10^2

8. What is the strain on a 60 ft cable if the enlongation is 2.5 in?

a) 0.042 c) 150

b) 0.0035 d) 1800

9. An aluminum cable has a 0.25 in diameter. What force would pull it in two if the ultimate tensile stress is 21 000 lb/in^2?

OVER

10. A 100 ft cable with a 1 in diameter lifts a load of 5000 lb
How much will its length increase if it is made of steel?
($Y = 29\ 000\ 000\ lb/in^2$)

TEST ANSWER KEYS

Module P 1 MECHANICAL PROPERTIES OF MATTER

PROBLEM	A	B	C	D	E
1	F	F	T	T	T
2	T	T	T	F	F
3	T	F	F	F	T
4	F	F	F	F	T
5	F	T	T	T	F
6	c	a	b	c	a
7	b	c	d	a	c
8	c	d	a	c	b
9	47 100 lb	5690 lb	29 500 lb	15 700 lb	1030 lb
10	26 300 lb	0.063 in	0.20 in^3	7400 lb/in^2	0.26 in^2

GRADING

NUMBER WRONG	GRADE (%)
0	100
1	90
2	80
3	70
4	60
5	50
6	40

TEST A

NAME_____

Module P 4 MOLECULAR PROPERTIES OF MATTER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Be sure to include your name in the space provided.

A	Electron	F	Capillarity
B	Neutron	G	Polarization
C	Atom	H	Ionic bond
D	Molecule	I	Positive ion
E	Surface tension	J	Negative ion

Match each of the following statements with the terms listed above. NOTE: Some may be used twice; some not at all.

_____ 1. An atom that has gained an excess of electrons.

_____ 2. A quantity that tends to reduce surface area.

_____ 3. A sub-atomic particle with a negative charge.

_____ 4. Sawdust poured on oil spots on the floor will soak up the oil.

_____ 5. The smallest particle that can take part in a chemical change.

_____ 6. The atomic mass minus the atomic number gives the approximate number of these particles in an atom.

_____ 7. Attraction between electrically charged atoms.

_____ 8. A phenomenon that gives rise to attractive forces between electrically neutral particles.

_____ 9. An atom that has been stripped of some of its electrons.

_____ 10. The smallest particle that retains most of the physical properties of the substance of which it is a part.

T - F 11. Calcium is in the 4th period (row) and the IIA column of the periodic chart. It therefore has two orbits containing electrons.

T - F 12. A discription of silver is shown in the box. It has 47 protons and about 61 neutrons.

47
Ag
107.868

T - F 13. An element is made up of atoms of a single kind.

OVER

T - F 14. Some liquids are depressed in fine bore tubes instead of being raised.

T - F 15. Diffusion and evaporation are two words that describe the same process.

T - F 16. A positive ion is an atom that has lost electrons.

T - F 17. No change occurs in the temperature of a liquid which is evaporating rapidly except for the loss of some of its molecules.

T - F 18. The pressure of a gas can be increased by expanding the volume of the gas.

T - F 19. The average kinetic energy of the molecules of a gas depends on both the temperature and pressure of the gas.

T - F 20. In liquids, the molecules have kinetic energy and can move around but seldom escape the cohesive bonds of other molecules.

NAME_____

TEST B

Module P 4 MOLECULAR PROPERTIES OF MATTER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Be sure to include your name in the space provided.

A	Proton	F	Gas
B	Neutron	G	Brownian motion
C	Ion	H	Avagadro's number
D	Isotope	I	Osmosis
E	Liquid	J	Diffusion

Match each of the following statements with the terms listed above. NOTE: Some may be used twice; some not at all.

_____ 1. A state of matter which has an indefinite shape but a definite volume.

_____ 2. An atom that doesn't have equal numbers of elec[illegible] and protons.

_____ 3. Different kinds of molecules travel through a bar[illegible]er at different rates.

_____ 4. Dust or smoke particles move about due to bombardment by air molecules even in stagnent air.

_____ 5. Of the three sub-atomic particles this one has the largest mass.

_____ 6. Molecules of a vapor tend to spread until they are evenly distributed within their container.

_____ 7. The kind of atom is determined by the number of these particles within it.

_____ 8. Atoms that have different numbers of neutrons in the nucleus.

_____ 9. A state of matter in which the molecules are far apart compared to their diameters.

_____ 10. This describes the number of molecules in a mole of a substance.

T - F 11. Iron is in the 4th period (row) of the periodic chart and is one of the transition elements. It therefore has four electrons in its outer orbit.

T - F 12. A description of copper is shown in the box. It has 35 protons and about 29 neutrons.

29
Cu
63.546

T - F 13. A compound is made up of molecules of a single kind.

OVER

T - F 14. Paint is held to metal on a car body by surface tension.

T - F 15. Diffusion of large molecules takes place much slower than that of smaller molecules.

T - F 16. A negative ion is an atom that has lost electrons.

T - F 17. Evaporation and sublimation both cause a cooling effect on the substance from which molecules escape.

T - F 18. The pressure of a gas can be increased by increasing the speed of the molecules.

T - F 19. The average kinetic energy of the molecules of a gas depends only on the temperature of the gas.

T - F 20. In solids, the molecules are locked in a certain position and cannot move at all.

NAME_____

TEST C

Module P 4 MOLECULAR PROPERTIES OF MATTER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Be sure to include your name in the space provided.

A	Atom	F	Orbit
B	Molecule	G	Crystal
C	Mole	H	Solid
D	Atomic mass	I	Liquid
E	Nucleus	J	Gas pressure

Match each of the following statements with the terms listed above. NOTE: Some may be used twice; some not at all.

_____ 1. A state of matter which has a definite shape and a definite volume.

_____ 2. The part of an atom in which electrons are found.

_____ 3. The smallest particle of a substance that has most of the physical properties of the substance.

_____ 4. The smallest particle that can take part in a chemical change.

_____ 5. The part of an atom that has a positive charge.

_____ 6. A quantity that can be changed by changing the number of molecules per unit volume.

_____ 7. A substance formed by an orderly array of molecules.

_____ 8. A quantity that can be changed by changing the speed of the molecules.

_____ 9. A quantity given by the number of protons and neutrons in an atom.

_____ 10. This quantity of any substance contains 6.02×10^{23} molecules.

T - F 11. Carbon is in the 2nd period (row) and the IVA column of the periodic chart. It therefore has four electrons in its outer orbit.

T - F 12. A description of germanium is shown in the box. It has 32 protons and about 41 neutrons.

32
Ge
72.59

T - F 13. The molecules of a compound are made up of atoms of a single kind.

OVER

T - F 14. Freely falling drops of water are shaped into a sphere by surface tension.

T - F 15. Diffusion of large molecules takes place much faster than that of smaller molecules.

T - F 16. A negative ion is an atom that has gained electrons.

T - F 17. When a liquid evaporates, it is the low speed molecules that escape. This increases the temperature of the liquid.

T - F 18. The pressure of a gas can be decreased by increasing the speed of the molecules.

T - F 19. The total energy of molecular motion appears in the form of friction.

T - F 20. In solids, the molecules are locked into a small space by cohesive bonds. The molecular motion is simply vibration usually confined to the small space.

NAME_____

TEST D

Module P 4 MOLECULAR PROPERTIES OF MATTER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Be sure to include your name in the space provided.

A	Ion	F	Avagadro's number
B	Isotope	G	Transition element
C	Homogeneous	H	Cooling effect
D	Heterogeneous	I	Sublimation
E	Brownian motion	J	Evaporation

Match each of the following statements with the terms listed above. NOTE: Some may be used twice; some not at all.

_____ 1. Dust or smoke particles move about due to the bombardment by air molecules even in stagnent air.

_____ 2. A vapor is emitted by solid moth ball crystals.

_____ 3. A description of a sample of matter that has the appearance of being only one kind of substance.

_____ 4. Almost all of these have two electrons in their outermost shell.

_____ 5. When molecules escape from solids or liquids the ones remaining have a reduced average kinetic energy.

_____ 6. Alcohol will emit a gaseous vapor, even below its boiling point.

_____ 7. With increasing atomic number, these have electrons added to incomplete inner orbits.

_____ 8. These are atoms that have the same atomic number but different atomic weights.

_____ 9. This describes the number of molucules in a mole of a substance.

_____ 10. These are atoms that don't have equal numbers of electrons and protons.

T - F 11. Sulfer is in the 3rd period (row) and the VIA column of the periodic chart. It therefore has seven electrons in its outer orbit.

T - F 12. A discription of mercury is shown in the box. It has 80 protons and about 121 neutrons.

80
Hg
200.59

T - F 13. The molecules of a compound are made up of atoms of at least two kinds.

OVER

T - F 14. Freely falling drops of water are shaped into a sphere by adhesion.

T - F 15. Evaporation takes place in liquids at a high temperature much slower than in a liquid of the same kind at a lower temperature.

T - F 16. A polarized molecule is one in which some of its electrons have been stripped away.

T - F 17. Evaporation rate depends on the temperature of the liquid. The higher the temperature the faster the molecules escape.

T - F 18. The pressure of a gas on a surface depends on how many molecules hit the surface per unit time and on the speed with which they hit the surface.

T - F 19. The total energy of molecular motion is the only kind of internal energy of a gas and can be removed in the form of heat.

T - F 20. In liquids, the molecules have some kinetic energy. Since they are free to move around, cohesive forces are ineffective.

NAME_____

TEST E

Module P 4 MOLECULAR PROPERTIES OF MATTER

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Be sure to include your name in the space provided.

A	Electrons	F	Temperature
B	Proton	G	Mixture
C	Neutron	H	Internal energy
D	Molecule	I	Mole
E	Negative charge	J	Atomic mass

Match each of the following statements with the terms listed above. NOTE: Some may be used twice; some not at all.

_____ 1. Some sub-atomic particles have more mass than these; some have less.

_____ 2. A sub-atomic particle with a negative charge.

_____ 3. Atoms that have an excess of electrons have this kind of electrical charge.

_____ 4. This quantity of any substance contains Avogadro's number of molecules.

_____ 5. A sample of material containing at least two kinds of base particles.

_____ 6. The atomic mass minus the atomic number gives the number of these particles in an atom.

_____ 7. A particle made up of one or more atoms.

_____ 8. The number of protons and neutrons gives this quantity for a given element.

_____ 9. This quantity is given by the sum of the kinetic energies of all the molecules in a gas.

_____ 10. This quantity is given by the average kinetic energy of the molecules in a gas.

T - F 11. Chlorine is in the 3rd period (row) and the VIIA column of the periodic chart. It therefore has seven electrons in its outer orbit.

T - F 12. A description of tin is shown in the box. It has 69 protons and about 50 neutrons.

50
Sn
118.69

T - F 13. The molecules of an element are made up of atoms of at least two kinds.

OVER

T - F 14. Paint is held to metal on a car body by adhesion.

T - F 15. Evaporation takes place in liquids at a high temperature much faster than in a liquid of the same kind at a lower temperature.

T - F 16. A polarized molecule is one which has more electrons than protons.

T - F 17. Evaporation causes a cooling effect on the substance from which molecules escape while sublimation causes a heating effect.

T - F 18. The pressure of a gas can be increased only by adding more gas to the space in which the gas is confined.

T - F 19. At a given temperature gases have a certain average kinetic energy. This means that light gas molecules will move at a higher average velocity than heavy gas molecules.

T - F 20. Molecular motion ceases altogether when a liquid freezes into a solid.

TEST ANSWER KEYS

Module P 4 MOLECULAR PROPERTIES OF MATTER

PROBLEM	A	B	C	D	E
1	J	E	H	E	B
2	E	C	F	I	A
3	A	I	B	C	E
4	F	G	A	G	I
5	C	B	E	H	G
6	B	J	J	J	C
7	H	A	G	G	D
8	G	D	J	B	J
9	I	F	D	F	H
10	D	H	C	A	F
11	F	F	T	T	T
12	T	F	T	T	F
13	T	T	F	T	F
14	T	F	T	F	T
15	F	T	F	F	T
16	T	F	T	F	F
17	F	T	F	T	F
18	F	T	F	T	F
19	F	T	F	T	T
20	T	F	T	F	F

OVER

GRADING

NUMBER WRONG	GRADE
0	100
1	95
2	90
3	85
4	80
5	75
6	70
7	65
8	60

DATA SHEET

Module M 5 MOVIN' ON (Motion)

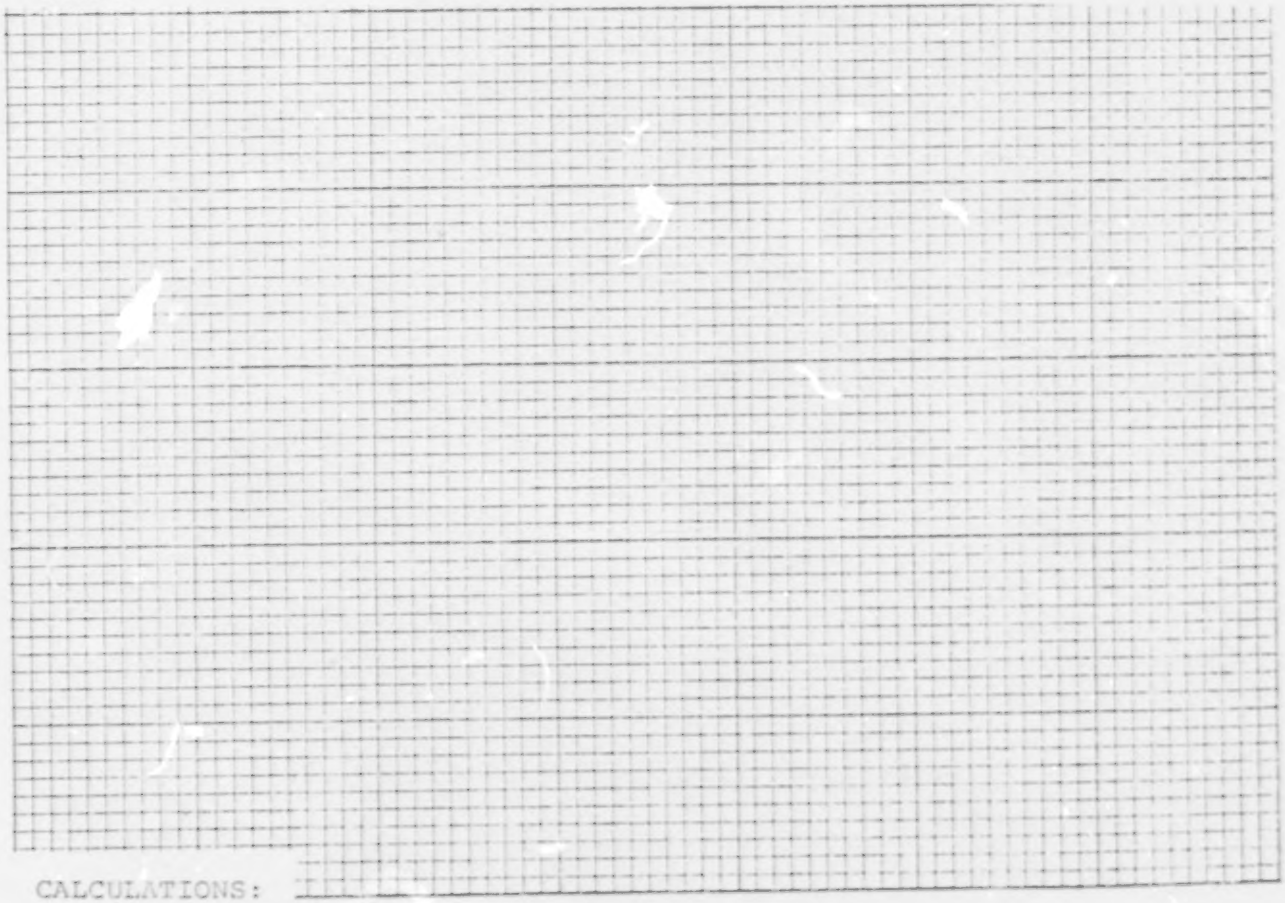
EXPERIMENT A

DATA:

t	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
s												

t	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
s												

GRAPH:



CALCULATIONS:

QUESTIONS (See Step 26).

EXPERIMENT B

DATA:

t	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1
s												
V_{av}												

t	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
s												
V_{av}												

GRAPH:

TABLE:

Interval	a
1, 2	
2, 3	
3, 4	
4, 5	
5, 6	

Interval	a
6, 7	
7, 8	
8, 9	
9, 10	
10, 11	

Interval	a
11, 12	
12, 13	
13, 14	
14, 1	
15, 16	

Calculations

a average=_____

sin 0 = _____

g = _____

g standard_____

% error_____

NAME_____

TEST A

Module M 5 MOVIN' ON (Motion)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Circle your final answers in problems 9 and 10. Be sure to include your name in the space provided.

T - F 1. A wrench dropped from rest will fall twice as far in 2 s as it does in 1 s.

T - F 2. An automobile having a speed of 45 mi/hr travels 135 mi in 3 h.

T - F 3. The downward acceleration of a steel ball depends on whether it was thrown downward or simply dropped.

T - F 4. An elevator just starting upward has an upward acceleration.

T - F 5. The acceleration of gravity is 980 cm/s^2.

6. An automobile goes from 35 mi/h to 55 mi/h with uniform acceleration. Its average velocity is:

a) 90 mi/hr c) 66 ft/s
b) 50 mi/hr d) 83.3 ft/s

7. A car has an initial velocity of 40 ft/s and an acceleration of 4 ft/s^2. In 10 s it travels how many feet?

a) 600 c) 400
b) 500 d) 440

8. Seventy-five miles per hour is equivalent to:

a) 46.6 km/h c) 66 ft/s
b) 88 ft/s d) 33.5 m/s

9. An elevator can accelerate at 4.3 m/s^2 to a maximum speed of 3 m/s. How far upward will it go in 5 s starting at rest?

10. A steel ball is thrown vertically upward with an initial speed of 90 ft/s from a bridge. If it just misses the bridge on its way back down, what is its displacement 7 s after being thrown?

NAME_____

TEST B

Module M 5 MOVIN' ON (Motion)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Circle your final answers on problems 9 and 10. Be sure to include your name in the space provided.

T - F 1. A wrench dropped from rest will fall half as far in 1 s as it does in 2 s.

T - F 2. A maintenance truck having a speed of 85 km/h travels 320 km in 4 h.

T - F 3. The downward acceleration of a steel ball is the same whether it was thrown upward or thrown downward.

T - F 4. An elevator moving upward comes to a stop. Its acceleration is upward.

T - F 5. The acceleration of gravity is 3.2×10^1 ft/s^2.

6. An automobile goes from 12 m/s to 28 m/s with uniform acceleration. Its average velocity is:

a) 18 m/s c) 2000 cm/s
b) 22 m/s d) 20 km/s

7. A car has an initial velocity of 40 ft/s and an acceleration of —4 ft/s^2. How far in feet does it go before coming to a stop?

a) 360 c) 300
b) 100 d) 200

8. Sixty-six feet per second is equivalent to:

a) 30 mi/h c) 60 mi/h
b) 72.1 km/h d) 28.1 km/h

9. If an elevator can accelerate at 6 ft/s^2 to a maximum speed of 5 ft/s, how far upward will it go in 15 s starting from rest?

10. Find the displacement after 2 s of a steel ball thrown vertically upward with an initial speed of 90 ft/s. Is it still going upward or is it on its way back down?

NAME_____

TEST C

Module M 5 MOVIN' ON (Motion)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. Circle your final answers in problems 9 and 10. Be sure to include your name in the space provided.

T - F 1. A wrench dropped from rest will fall one-fourth as much in 1 s as in 2 s.

T - F 2. A maintenance helicopter having a speed of 65 km/h travels 455 km in 7 h.

T - F 3. The acceleration of a steel ball thrown upward is the same as it goes upward as it is on the return downward.

T - F 4. An elevator moving downward comes to a stop. Its acceleration is downward.

T - F 5. The acceleration of gravity is 9.8×10^2 m/s^2.

6. An automobile goes from 42 ft/s to 68 ft/s with uniform acceleration. Its average velocity is:

a) 37.5 mi/h
b) 55 mi/h
c) 50 ft/s
d) 60 ft/s

7. A car has an initial velocity of 55 ft/s and an acceleration of -5 ft/s^2. How far in feet does it go before coming to a stop?

a) 55
b) 550
c) 303
d) 30.3

8. One-hundred ten feet per second is equivalent to:

a) 60 mi/h
b) 120 km/h
c) 90 mi/h
d) 46.8 km/h

9. If a freight elevator can accelerate at 1 ft/s^2 to a maximum speed of 0.5 ft/s, how far upward will it go in 1 min starting at rest?

10. A steel ball is thrown vertically upward with an initial speed of 25 m/s from a bridge. If it just misses the bridge on its way back down, what is its displacement 7 s after being thrown?

NAME_____

TEST D

Module M 5 MOVIN' ON (Motion)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle your choice. Circle the final answers in problems 9 and 10. Be sure to include your name in the space provided.

T - F 1. A screwdriver dropped from rest will fall three times as far in 3 s as in 1 s.

T - F 2. A maintenance vehicle having a speed of 75 km/h travels 525 km in 7 h.

T - F 3. The acceleration of a metal ball thrown upward is the same at the peak of its flight as it is before it reaches the peak.

T - F 4. An elevator just starting downward has a downward acceleration.

T - F 5. The acceleration of gravity is 9.8 cm/s^2.

6. An automobile goes from 1800 cm/s to 4200 cm/s with uniform acceleration. Its average velocity is:

a) 2000 cm/s c) 3000 m/s
b) 0.03 km/s d) 20 m/s

7. A stone thrown vertically upward at 80 ft/s will continue to rise for how many seconds before reaching its peak?

a) 7.5 c) 1.5
b) 4 d) 2.5

8. Fifty kilometers per hour is equivalent to:

a) 31.2 ft/s c) 45.8 ft/s
b) 80 mi/h d) 45.8 mi/h

9. If a freight elevator can accelerate at 0.5 ft/s^2 to a maximum speed of 1 ft/s, how far upward will it go in 1 min starting at rest?

10. Find the displacement after 5 s of a steel ball thrown vertically upward with an initial speed of 25 m/s. Is it still going upward or is it on its way back down?

NAME_____

TEST E

Module M 5 MOVIN' ON (Motion)

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle your answer. Circle the final answers in problems 9 and 10. Be sure to include your name in the space provided.

T - F 1. A wrench dropped from rest will fall nine times as far in 3 s as in 1 s.

T - F 2. A maintenance vehicle having a speed of 58 mi/h travels 240 mi in 5 h.

T - F 3. The acceleration of a steel ball thrown upward is zero at the peak of its flight.

T - F 4. An elevator moving downward comes to a stop. Its acceleration is upward.

T - F 5. The acceleration of gravity is 384 in/s^2.

6. An automobile goes from 66 ft/s to 88 ft/s with uniform acceleration. Its average velocity is:

a) 52.5 mi/h c) 70 ft/s
b) 77 mi/h d) 80 ft/s

7. A stone thrown vertically upward at 24.5 m/s will continue to rise for how many seconds before reaching its peak?

a) 7.5 c) 4
b) 2.5 d) 1.5

8. One-hundred kilometers per hour is equivalent to:

a) 62.4 ft/s c) 91.6 mi/h
b) 160 mi/h d) 91.6 ft/s

9. If an elevator can accelerate at 1.3 m/s^2 to a maximum speed of 2.3 m/s, how far upward will it go in 30 s starting at rest?

10. Find the displacement after 3 s of a steel ball thrown vertically upward with an initial speed of 25 m/s. Is it still going upward or is it on its way back down?

TEST ANSWER KEYS

Module M 5 MOVIN' ON (Motion)

PROBLEM	A	B	C	D	E
1	F	F	T	F	T
2	T	F	T	T	F
3	F	T	T	T	F
4	T	F	F	T	T
5	T	T	F	F	T
6	c	c	a	b	a
7	a	d	c	d	b
8	d	b	b	c	d
9	14.0 m	72.9 ft	29.9 ft	59 ft	67.0 m
10	-154 ft	116 ft +	-65.1 m	2.5 m +	30.9 m +

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

DATA SHEET

Module M 3 THE NATURE OF VECTORS

	Polar Form		Rectangular Form	
	magnitude	direction	x-component	y-component
Force A				
Force B				
Force C				
Resultant R				
Equilibrant E				

VECTOR POLYGON

Conclusions and Observations

CALCULATIONS:

NAME _____

TEST A

Module M 3 THE NATURE OF VECTORS

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. A vector is a quantity fully represented by a number and a unit.

T - F 2. If a force of 35 lb makes an angle of 35° with the x-axis. Its component in the y-direction is 28.7 lb.

T - F 3. Vector diagrams must be drawn to accurate scale for the resultant to be shown correctly.

T - F 4. Displacements of 2, 4, and 14 kilometers would allow an automobile to return to its starting point if the directions happen to be in a correct combination.

T - F 5. The process of separating vectors into their rectangular components is called vector composition.

6. A force of 60 N makes an angle of 40° with the x-axis. Its vertical component in newtons is:

a) 46.0 c) 78.3
b) 93.3 d) 38.6

7. Displacements of 8 km and 6 km, if the directions were correct, could be added to give a resultant magnitude in kilometers of:

a) 0 c) 15
b) 1 d) 11

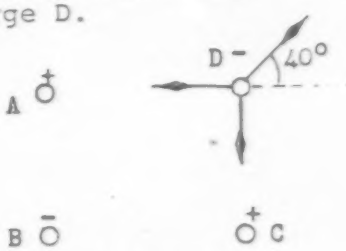
8. A force of 15 N acts perpendicular to a force of 11 N. The resultant has a magnitude in newtons of:

a) 18.6 c) 346
b) 26 d) 4

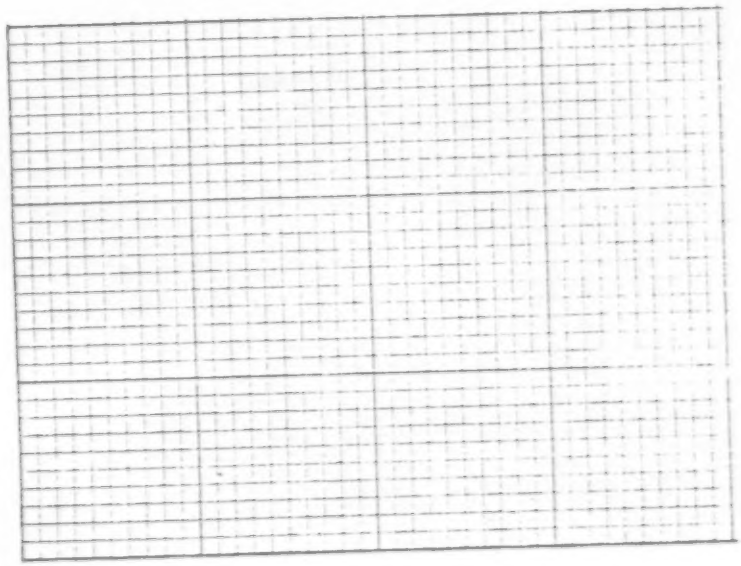
9. An automobile travels 5 miles east and then 7 miles at 35° north of east. The magnitude of the resulting displacement in miles is:

a) 18.2 c) 11.1
b) 9.50 d) 12.0

10. Four electric charges are located at the vertices of a rectangle as shown in the accompanying diagram. Each charge exerts a force on each of the others. The forces on charge D are F_A = 5 dynes, F_B = 8 dynes, and F_C = 12 dynes with directions shown in the diagram. Find the resultant (magnitude and direction) of the forces on charge D.



11. Construct a careful freehand vector polygon on the graph paper provided. Plot the following displacements: 85.3 km at 25.3°, 64.4 at 296°, and 47.6 km at 163°. All angles are measured from the positive x-axis. Draw in the resultant and estimate its magnitude and direction.



NAME_____

TEST B

Module M 3 THE NATURE OF VECTORS

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. A scalar is a quantity represented by a number, unit and direction

T - F 2. If a force of 25 lb makes an angle of 35° with the x-axis, its component in the x-direction is 14.3 lb.

T - F 3. If the resultant of three concurrent forces has zero magnitude, their vectors will plot to form a closed triangle.

T - F 4. Displacements of 1, 3, 8, and 13 kilometers would allow an automobile to return to its starting point if the directions happen to be in a correct combination.

T - F 5. When two or more vectors are added together, the order in which they are added, graphically, doesn't matter.

6. A force of 85 N makes an angle of 55° with the x-axis. Its horizontal component in newtons is:

a) 69.6 c) 48.8
b) 104 d) 148

7. A displacement of 12 miles and 8 miles, if the directions were correct, could be added to give a resultant magnitude in miles of:

a) 0 c) 3
b) 6 d) 21

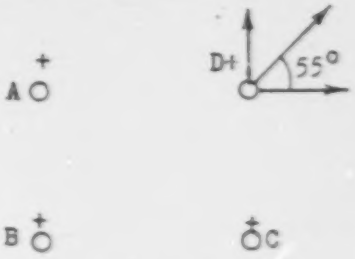
8. A force of 7 lb acts perpendicular to a force of 16 lb. The resultant has a magnitude in pounds of:

a) 305 c) 17.5
b) 9.00 d) 23.0

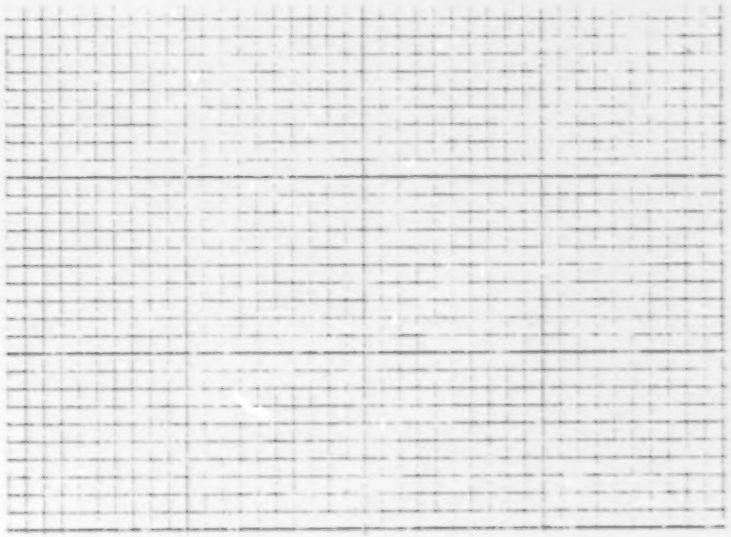
9. An automobile travels 7 km west and 6 km at 30° north of west. The magnitude of the resulting displacement in kilometers is:

a) 12.6 c) 13.0
b) 18.6 d) 6.50

10. Four electric charges are located at the vertices of a rectangle as shown in the accompanying diagram. Each charge exerts a force on each of the others. The forces on charge D are F_A = 6 dynes, F_B = 9 dynes, and F_C = 13 dynes with directions shown on the diagram. Find the resultant (magnitude and direction) of the forces on charge D.



11. Construct a careful freehand vector parallelogram on the graph paper provided. Plot the following pair of forces: 366 N at 25.6° and 528 N at 109°. Both angles are measured from the positive x-axis. Draw in the resultant and estimate its magnitude and direction.



NAME_____

TEST C

Module M 3 THE NATURE OF VECTORS

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The magnitude of a vector is given by the units of the vector.

T - F 2. If a force of 35 lb makes an angle of 35° with the x-axis, its component in the x-direction is 28.7 lb.

T - F 3. The vector sum of two or more forces is called their resultant.

T - F 4. Displacements of 6, 7, 4, and 19 km would allow an automobile to return to its starting point if their directions happen to be in a correct combination.

T - F 5. When two or more vector are added together, the order in which they are added will make a difference in the resultant.

6. A force of 40 N makes an angle of 70° with the x-axis. Its horizontal component in newtons is:

a) 37.6 c) 117
b) 13.7 d) 42.6

7. A displacement of 6 km and 16 km, if the directions were correct, could be added to give a resultant magnitude in kilometers of:

a) 21 c) 5
b) 0 d) 24

8. A force of 6 lb acts perpendicular to a force of 13 lb. The resultant has a magnitude in pounds of:

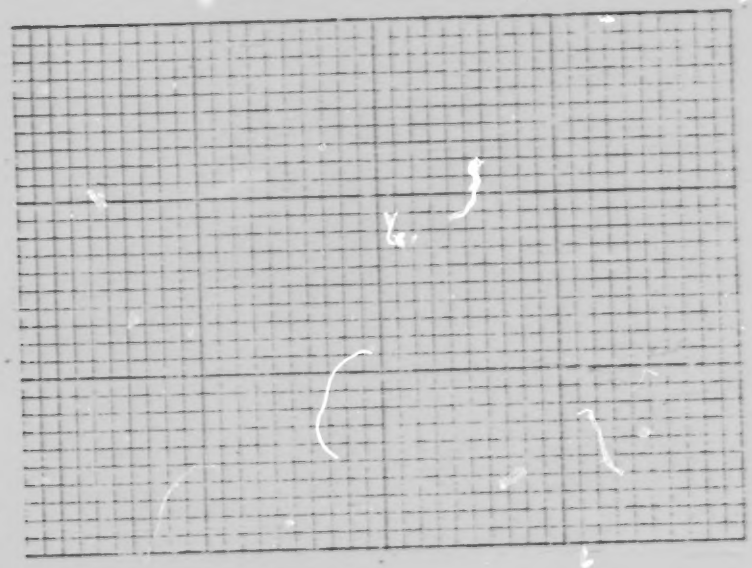
a) 7.00 c) 19.0
b) 205 d) 14.3

9. An automobile travels 9 miles south and then 8 miles at 60° south of west. The magnitude of the resulting displacement in miles is:

a) 8.50 c) 17.0
b) 19.7 d) 14.7

10. Four electric charges are located at the vertices of a rectangle as shown in the diagram. Each charge exerts a force on each of the others. The forces on charge D are F_A = 8 dynes, F_B = 15 dynes, and F_C = 22 dynes with directions shown. Find the resultant (magnitude and direction) of the forces on charge D.

11. Construct a careful freehand vector polygon on the graph paper provided. Plot the following forces: 76 lb at 37.5°, 107 lb at 116°, and 53 lb at 243°. All angles are measured from the positive x-axis. Draw in the resultant and estimate its magnitude and direction.



NAME_____

TEST D

Module M 3 THE NATURE OF VECTORS

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The magnitude of a vector is given by the number and its units.

T - F 2. If a displacement makes an angle of 65° with the x-axis and has an x-component of 35 ft, its magnitude is 82.8 ft.

T - F 3. The equilibrant of several forces is the same as their resultant.

T - F 4. Displacements of 5, 4, 7, and 15 km would not allow an automobile to return to its starting point even if the directions happen to be in a correct combination.

T - F 5. The process of combining vectors by addition is called vector composition.

6. A force of 20 N makes an angle of 65° with the x-axis. Its vertical component in newtons is:

a) 8.45 c) 47.3
b) 22.1 d) 18.1

7. A displacement of 15 km and 5 km, if the directions were correct, could be added to give a resultant magnitude in kilometers of:

a) 7 c) 19
b) 32 d) 0

8. A force of 8 N acts perpendicular to a force of 14 N. The resultant has a magnitude in newtons of:

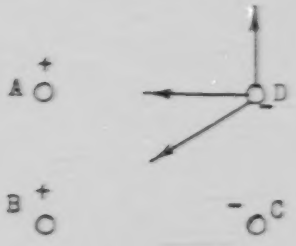
a) 16.1 c) 260
b) 6.00 d) 22.0

9. An automobile travels 8 miles east and then 6 miles at 30° west of north. The magnitude of the resulting displacement in miles is:

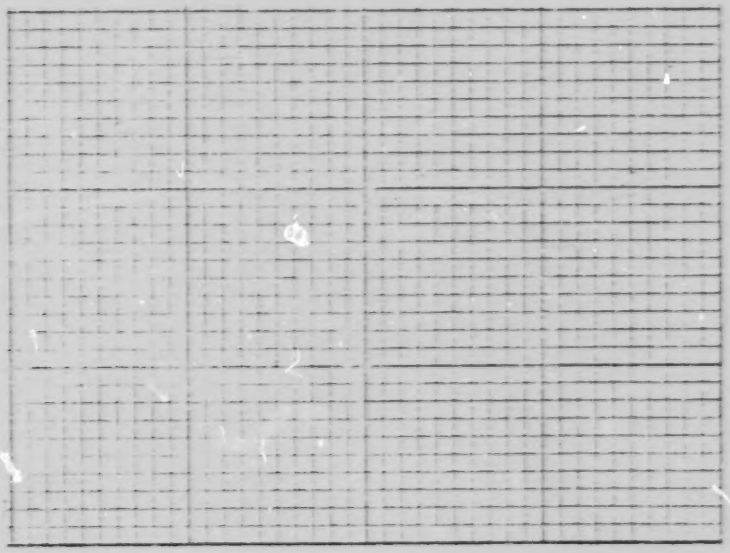
a) 14.0 c) 7.00
b) 6.56 d) 15.7

TEST D Continued:

10. Four electric charges are located at the vertices of a rectangle as shown in the diagram. Each charge exerts a force on each of the others. The forces on charge D are F_A = 2 dynes, F_B = 6 dynes, and F_C = 9 dynes, with directions shown. Find the resultant (magnitude and direction) of the forces on charge D.



11. Construct a careful freehand vector <u>parallelogram</u> on the graph paper provided. Plot the following pair of displacements: 74.7 miles at 128°, and 107 miles at 203°. Both angles are measured from the positive x-axis. Draw in the resultant and estimate its magnitude and direction.



NAME _____

TEST E

Module M 3 THE NATURE OF VECTORS

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 10 and 11, circle your final answer. Be sure to include your name in the space provided.

T - F 1. A vector is a quantity that must have both magnitude and direction to be fully described.

T - F 2. If a displacement makes an angle of 65° with the x-axis and has a y-component of 35 ft, its magnitude is 82.8 ft.

T - F 3. The equilibrant of several forces has the same magnitude as the resultant but is opposite in direction.

T - F 4. Displacements of 3, 8, 2, and 12 miles would not allow an automobile to return to its starting point even though the directions were in a correct combination.

T - F 5. The process of combining vectors by addition is called vector resolution.

6. A force of 35 N makes an angle of 35° with the x-axis. Its vertical component in newtons is:

a) 61.0 c) 28.7
b) 20.1 d) 42.7

7. A displacement of 15 km and 5 km, if the directions were correct, could be added to give a resultant magnitude in kilometers of:

a) 4 c) 2
b) 25 d) 0

8. A force of 12 N acts perpendicular to a force of 17 N. The resultant has a magnitude in newtons of:

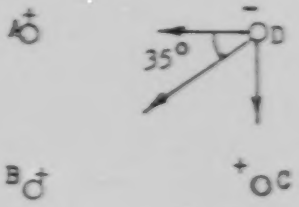
a) 433 c) 29.0
b) 5.00 d) 20.8

9. An automobile travels 5 miles south and then 4 miles at 60° west of south. The magnitude of the resulting displacement in miles is:

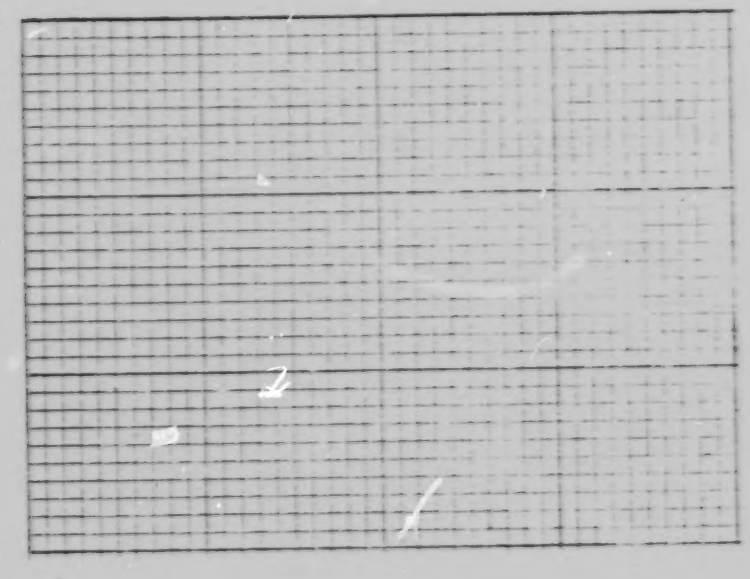
a) 8.20 c) 7.81
b) 5.00 d) 11.6

TEST E Continued:

10. Four electric charges are located at the vertices of a rectangle as shown in the diagram. Each charge exerts a force on each of the others. The forces on charge D are: F_A = 0.3 dynes, F_B = 0.7 dynes, and F_C = 0.5 dynes with directions shown. Find the resultant (magnitude and direction) of the forces on charge D.



11. Construct a careful freehand vector <u>polygon</u> on the graph paper provided. Plot the following forces: 25.6 N at 147°, 52.1° at 205° and 46.3° at 327°. All angles are measured from the positive x-axis. Draw in the resultant and estimate its magnitude and direction.



ANSWER KEYS

Module M 3 THE NATURE OF VECTORS

Problem #	Test A	Test B	Test C	Test D	Test E
1.	F	F	F	T	T
2.	F	F	T	T	F
3.	T	T	T	F	T
4.	F	F	F	F	F
5.	F	T	F	T	F
6.	d	c	b	d	b
7.	d	b	a	c	a
8.	a	c	d	a	d
9.	c	a	d	b	c
10.	$6.95/\underline{-80.7^\circ}$	$23.2/\underline{61.3^\circ}$	$28.9/\underline{78.8^\circ}$	$9.37/\underline{140^\circ}$	$1.25/\underline{-134^\circ}$
11.	$59.8/\underline{-7.6^\circ}$ Answers are	$676/\underline{77^\circ}$ calculated	$95.9/\underline{96^\circ}$ Estimates	$146/\underline{173^\circ}$ should be	$44.8/\underline{-132^\circ}$ close

GRADING

Number Wrong	Grade
0	100
1	91
2	82
3	73
4	64
5	55
6	44

DATA SHEET

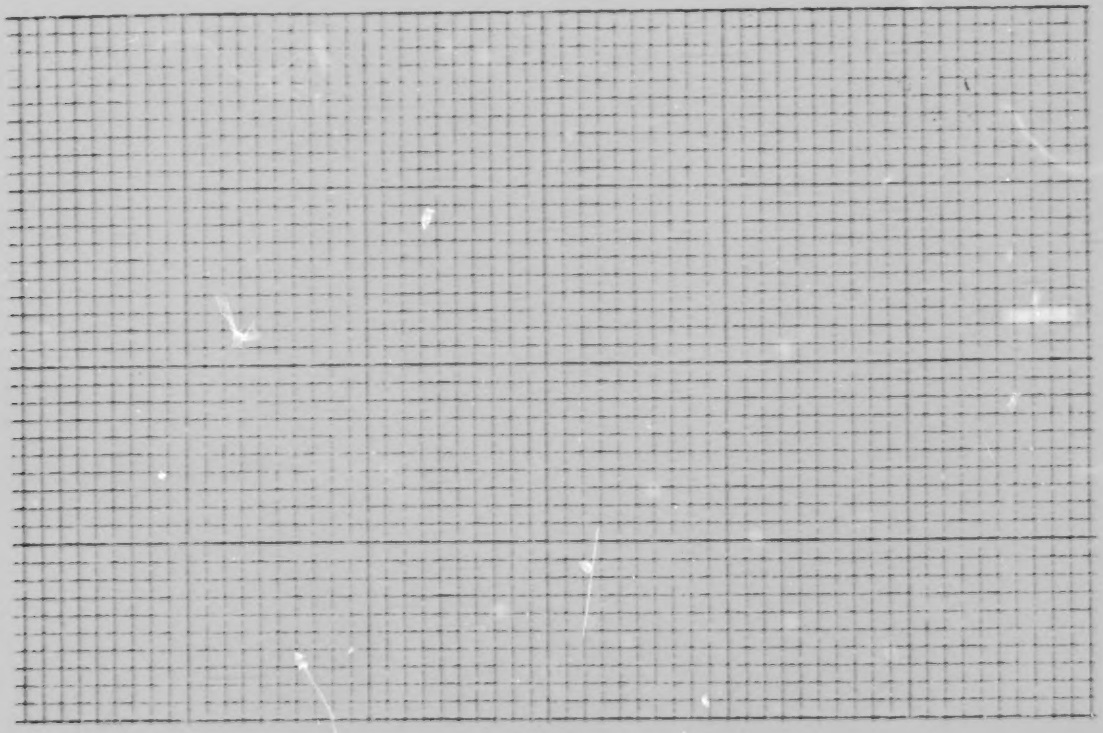
Module M 11 POWER TRANSMISSION

TABLE I

Trial	Angular Speed (rps)	F_1 (kg)	F_2 (kg)	Power Input (watts)	Power Output (watts)	Efficiency (%)	Torque (N·m)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Diameter of pulley (d). . . .cm _____ m

GRAPH:



TEST A NAME_____

Module M 11 POWER TRANSMISSION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Angular acceleration and centripetal acceleration are two vectors that point in opposite directions.

T - F 2. The moment of inertia of two objects with the same mass will always be the same.

T - F 3. When one spur gear drives another, the smaller gear of the two is called the pinion; the larger is a ring gear.

T - F 4. A ring gear with 54 teeth will rotate six times faster than the pinion with 9 teeth that drives it.

T - F 5. One horsepower equals 746 watts.

6. A grinding wheel accelerates from rest to 183 rad/s. The angular acceleration is 57.3 rad/s^2. The time required is:

a) 0.31 s c) 3.2 s
b) 174 s d) 1 s

7. What torque is developed by an engine if the power is 40 hp at an angular speed of 800 rpm?

a) 3350 lb ft c) 20 lb ft
b) 32 000 lb ft d) 263 lb ft

8. What is the torque ratio of a spur ring gear and pinion if the efficiency is 90%? The ring gear with 45 teeth drives the pinion with 9 teeth.

a) 4.5 c) 5.88
b) 0.24 d) 0.17

9. A drive shaft on an automobile is in the form of a pipe 8 cm in diameter; its mass is 25 kg. What is its rotational kinetic energy when rotating at 3000 rpm?

10. A Prony brake is used to measure the torque produced by a small electric motor. The pulley has a 1.125 in diameter and the scales read 72 oz and 6 oz when the speed is 1750 rpm. What torque is produced by this load?

TEST B NAME_____

Module M 11 POWER TRANSMISSION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Centripetal acceleration is always the result of a torque applied to a rotating object.

T - F 2. Large moments of inertia are obtained by concentrating the mass of rotating objects as far from the axis of rotation as possible.

T - F 3. The axis of a beveled ring gear is perpendicular to the axis of the pinion that drives it.

T - F 4. A worm gear drives a ring gear with 12 teeth. The worm rotates 12 times faster than the ring gear.

T - F 5. One horsepower equals 746 joules.

6. Neglecting spokes and hub, a flywheel is in the form of a hoop with a 16 in average diameter. Its mass is 2 slug (64 lb). Its moment of inertia is slug feet squared is:

a) 0.89
b) 2.67
c) 0.44
d) 5.33

7. An engine develops a torque of 290 lb ft at 2000 rpm. What horsepower is developed?

a) 11 hp
b) 69 hp
c) 110 hp
d) 144 hp

8. What is the torque ratio of a helical ring gear and pinion if the efficiency is 85%? The pinion is the driver and has 8 teeth. The ring gear has 40 teeth.

a) 5.88
b) 4.25
c) 0.17
d) 0.24

9. An armature of a motor has a moment of inertia of 0.02 slug ft^2. What is its rotational kinetic energy when rotating at 1750 rpm?

10. The drum of a Prony brake has a diameter of 1.5 ft. When the drum rotates at 3000 rpm, the balances read 100 lb and 400 lb. Find the brake horsepower of the engine.

TEST C NAME_____

Module M 11 POWER TRANSMISSION

Read each question carefully and decide which answer is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Angular acceleration is always the result of a torque applied to a rotating object.

T - F 2. Two objects with the same mass and angular velocity will always have the same rotational kinetic energy.

T - F 3. The axis of a ring gear is perpendicular to the axis of the worm gear that drives it.

T - F 4. A 3 in V-belt pulley drives a 9 in pulley. The larger pulley rotates three time faster than the smaller one.

T - F 5. Five-hundred-fifty foot pounds per second equals 746 watts.

6. A flywheel is in the form of a disc with a 16 in diameter. Its mass is 2 slug (64 lb). Its moment of inertia in slug feet squared is:

a) 0.44
b) 0.89
c) 2.67
d) 5.33

7. An engine develops a torque of 280 lb ft when the power output is 140 hp. What is the angular speed in revolutions per minute?

a) 275
b) 2630
c) 4220
d) 3240

8. A bevel ring gear and pinion has a torque ratio of 3.8. The ring gear has 36 teeth and the pinion has 9. What is the efficiency?

a) 90%
b) 85%
c) 95%
d) 80%

9. A grindstone is in the form of a disc with a 30 cm diameter. It weighs 4 kg. Calculate the rotational kinetic energy when it is rotating at 1800 rpm.

10. The drum of a Prony brake has a diameter of 1.5 ft. When the drum rotates at 3000 rpm the balances read 100 lb and 400 lb. Find the torque produced by the engine.

TEST D NAME_____

Module M 11 POWER TRANSMISSION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Angular acceleration is always the result when a rotating object has a tangential acceleration.

T - F 2. Two objects with the same moment of inertia and angular velocity will always have the same rotational kinetic energy if they rotate about the same axis.

T - F 3. A rack wil rotate clockwise if the pinion that drives it rotates clockwise.

T - F 4. A beveled ring gear has 45 teeth. The pinion that drives it must have 9 teeth if the speed ratio is 5.

T - F 5. One kilowatt equals 0.746 horsepower.

6. A torque wrench 16 in long reads 60 lb ft. What force is applied to the handle?

a) 3.75 lb
b) 80 lb
c) 960 lb
d) 45 lb

7. An electric motor develops 2.3 Nm of torque at a speed of 1680 rpm. What is the power output in watts?

a) 730
b) 76
c) 405
d) 12.2

8. How many teeth does a pinion have that drives a ring gear with 80 teeth? The efficiency is 90% and the torque ratio is 4.5.

a) 16
b) 8
c) 32
d) 64

9. A drive shaft on an automobile is in the form of a solid cylinder. It weighs 15 kg and is 4 cm in diameter. What is its rotational kinetic energy when it is rotating at 2800 rpm?

10. A Prony brake has a drum with a 15 cm radius. The spring balances read 242 N and 48 N when the motor speed is 1750 rpm. If the input to the electric motor is 6 kW, what is its efficiency?

TEST E NAME_____

Module M 11 POWER TRANSMISSION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. Centripetal and tangential acceleration are linear qualities and have units of m/s^2 (mks) while angular acceleration has units of rad/s^2.

T - F 2. Large moments of inertia are obtained by concentrating the mass of rotating objects as close to the center of rotation as possible.

T - F 3. The driving shaft and the driven shaft will rotate in opposite directions when the link between them is a V-belt system.

T - F 4. Two spur gears are meshed with an idler gear between them. If the driver has 48 teeth and the driven gear has 12 teeth, the speed ratio is 4.

T - F 5. One kilowatt equals 1.34 horsepower.

6. A phonograph turntable accelerates from rest to 45 rpm with an acceleration of 37.1 rad/s^2. How much time is required?

a) 1.21 s
b) 7.87 s
c) 0.127 s
d) 4.29 s

7. An electric motor develops a power output of 249 watts when the torque is 1.4 Nm. What is the angular speed in revolutions per minute?

a) 1680
b) 1700
c) 1720
d) 1740

8. A compound set of spur gears has individual speed ratios of 22, 4, 0.125, and 1. What is the overall speed ratio?

a) 352
b) 27.125
c) 11
d) 44

9. A grinding wheel has a 10 in diameter. The maximum speed it was designed for is 1240 rpm. What kinetic energy does it have at this speed? Its weight is 6 lb.

10. A Prony brake has a pulley with a 2.86 cm diameter. The scale readings are 40 N and 5 N when the angular speed is 1675 rpm. If the power input to this small motor is 105 W, find the efficiency.

TEST ANSWER KEYS

Module M 11 POWER TRANSMISSION

PROBLEM	A	B	C	D	E
1.	F	F	T	T	T
2.	F	T	F	T	F
3.	T	T	T	F	F
4.	F	T	F	T	F
5.	T	F	T	F	T
6.	c	a	a	d	c
7.	d	c	b	c	b
8.	a	b	c	a	c
9.	1970 J	336 ft lb	799 J	129 J	137 ft lb
10.	0.0965 lb ft	129 hp	225 lb ft	89%	84%

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

DATA SHEET

Module M 12 SIMPLE HARMONIC MOTION

EXPERIMENT A MASS ON A SPRING

Step 4 y_1 = _____ cm

Step 5 y_2 = _____ cm

Step 6 Δy = _____ cm

F _____ dynes

Step 7 k _____ dynes/cm

Step 8 m _____ g

Step 9 T _____ s

Step 11 t _____ s

number _____

Step 12 T _____ s

Step 13 error _____ %

Step 14 f _____ Hz

ω _____ rad/s

v max _____ cm/s

a max _____ cm/s^2

Total energy _____ J

Step 15

OVER

EXPERIMENT B THE PENDULUM

Step 5 t _____ s

number _____

Step 6 T _____ s

Step 7 L _____ cm

Step 8 g _____ cm/s^2

Step 10 error _____ %

Calculations:

NAME_____

TEST A

Module M 12 SIMPLE HARMONIC MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. A radian is an angle at the center of a circle whose arc length is equal to the circumference of the circle.

T - F 2. Elastic potential energy is continuously being converted to gravitational potential energy and back in the operation of a mass on a spring.

T - F 3. In simple harmonic motion, the frequency is independent of the amplitude.

T - F 4. The speed of an object vibrating in SHM as it passes through the equilibrium point depends on the amplitude.

T - F 5. The product of the period and frequency in simple harmonic motion is always equal to 1(one).

6. An object undergoes SHM with an amplitude of 3 in. Its maximum acceleration occurs when its displacement is:

a) zero
c) 6 in
b) 1.5 in
d) 3 in

7. A simple pendulum is 6 ft long. ($g = 32\ ft/s^2$). Its period is:

a) 1.36 s
c) 2.72 s
b) 1.18 s
d) none of these

8. If $y = 6 \sin 120\pi t$ is the equation of an object vibrating in SHM, find the frequency:

a) 60 Hz
c) 240 Hz
b) 120 Hz
d) 565 Hz

9. What is the total energy of a pendulum bob if its mass is 0.03 slug? The frequency is 3 Hz and the amplitude is 3 in.

OVER

10. An object is vibrating in SHM with an amplitude of 4 units. The frequency is 60 Hz. Write the equation for displacement as a function of time. (t = 0 at the equilibrium point).

NAME_____

TEST B

Module M 12 SIMPLE HARMONIC MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. A radian is an angle at the center of a circle whose arc length is equal to the radius of the circle.

T - F 2. The energy content of a pendulum is continuously being exchanged between the gravitational potential energy of the bob and its kinetic energy.

T - F 3. In simple harmonic motion, the period is independent of the frequency.

T - F 4. The speed of an object vibrating in SHM at the midpoint of its path depends on the angular frequency.

T - F 5. The frequency of an object vibrating in SHM is 2π times the angular frequency.

6. An object undergoes SHM with a total range of motion of 12 cm. The maximum velocity occurs when the displacement is:

a) zero
b) 3 cm
c) 6 cm
d) 12 cm

7. The mass on a spring is 1 kg. The spring constant is 39.48 N/m. Its period is:

a) 0.16 s
b) 1 s
c) 2 s
d) none of these

8. If $y = 1.5 \sin 800\pi t$ is the equation of an object vibrating in SHM, find the amplitude.

a) 2513 units
b) 400 units
c) 800 units
d) 1.5 units

9. What is the total energy of a 0.75 kg mass on a spring if the frequency is 0.5 Hz and the amplitude is 3 cm?

OVER

10. An object is vibrating is SHM with an amplitude of 2 cm. The angular frequency is 140π rad/s. Write the equation for displacement as a function of time. (t = 0 at the equilibrium point).

NAME_____

TEST C

Module M 12 SIMPLE HARMONIC MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Two π-radians is an angle at the center of a circle whose arc length is equal to the circumference of the circle.

T - F 2. The energy content of a pendulum is never exchanged between the kinetic energy of the bob and its gravitational potential energy.

T - F 3. In simple harmonic motion, the period depends solely on the amplitude.

T - F 4. The speed of an object vibrating in SHM at the midpoint of its path depends on the period.

T - F 5. The amplitude of a body undergoing simple harmonic motion is one-half of its total range of motion.

6. An object undergoes SHM with a total range of motion of 7 cm. The acceleration is zero when its displacement is:

a) maximum c) 3.5 cm

b) zero d) 7 cm

7. A mass on a spring is 2 kg. The spring constant is 19.74 N/m. Its period is:

a) 0.5 s c) 1 s

b) 0.64 s d) 2 s

8. If $y = 3 \sin 10\pi t$ is the equation of an object vibrating in SHM, find the period.

a) 0.2 s c) 3 s

b) 31.4 s d) 5 s

9. What is the total energy of an object vibrating in SHM if its mass is 1 kg? The frequency is 100 Hz and the amplitude is 1 mm.

OVER

10. Write the equation for displacement as a function of time for an object vibrating (SHM) with an amplitude of 5 cm and a frequency of 5 Hz. (t = 0 at the equilibrium point).

NAME_____

TEST C

Module M 12 SIMPLE HARMONIC MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Two π-radians is an angle at the center of a circle whose arc length is equal to the circumference of the circle.

T - F 2. The energy content of a pendulum is never exchanged between the kinetic energy of the bob and its gravitational potential energy.

T - F 3. In simple harmonic motion, the period depends solely on the amplitude.

T - F 4. The speed of an object vibrating in SHM at the midpoint of its path depends on the period.

T - F 5. The amplitude of a body undergoing simple harmonic motion is one-half of its total range of motion.

6. An object undergoes SHM with a total range of motion of 7 cm. The acceleration is zero when its displacement is:

a) maximum c) 3.5 cm

b) zero d) 7 cm

7. A mass on a spring is 2 kg. The spring constant is 19.74 N/m. Its period is:

a) 0.5 s c) 1 s

b) 0.64 s d) 2 s

8. If $y = 3 \sin 10\pi t$ is the equation of an object vibrating in SHM, find the period.

a) 0.2 s c) 3 s

b) 31.4 s d) 5 s

9. What is the total energy of an object vibrating in SHM if its mass is 1 kg? The frequency is 100 Hz and the amplitude is 1 mm.

OVER

10. Write the equation for displacement as a function of time for an object vibrating (SHM) with an amplitude of 5 cm and a frequency of 5 Hz. (t = 0 at the equilibrium point).

NAME _____

TEST E

Module M 12 SIMPLE HARMONIC MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. An angle at the center of a circle whose arc length is equal to one-half the circumference of the circle is one π-radian.

T - F 2. The energy content of an object vibrating in SHM is continuously being exchanged between kinetic energy and some form of potential energy.

T - F 3. In simple harmonic motion, the amplitude depends solely on the frequency.

T - F 4. The maximum speed of a pendulum bob depends on its mass.

T - F 5. The amplitude of a body undergoing simple harmonic motion is twice the total range of motion.

6. An object undergoes SHM with a total range of motion of 6 cm. Its amplitude is:

a) zero
c) 3 cm
b) 1.5 cm
d) 6 cm

7. A simple pendulum is 0.25 m long. ($g = 9.80\ m/s^2$). Its frequency is:

a) 1 s
c) 0.16 Hz
b) 1 Hz
d) 6.2 Hz

8. If $y = 5 \sin 100\pi t$ is the equation of an object vibrating in SHM, find the angular frequency.

a) 5 rad/s
c) 314 rad/s
b) 100 rad/s
d) 50 rad/s

9. What is the total energy of a pendulum bob if its mass is 5 g, the amplitude is 5 cm and the frequency is 10 Hz?

OVER

10. Write the equation for displacement as a function of time for an object vibrating (SHM) with an angular frequency of 70π rad/s and an amplitude of 4.3 mm. (t = 0 at the equilibrium point).

TEST ANSWER KEYS

Module M 12 SIMPLE HARMONIC MOTION

PROBLEM	A	B	C	D	E
1	F	T	T	F	T
2	F	T	F	F	T
3	T	F	F	T	F
4	T	T	T	F	F
5	T	F	T	T	F
6	d	a	b	a	c
7	c	b	d	c	b
8	a	d	a	b	c
9	0.333 ft lb	0.0033 J or 33 300 erg	0.197 J or 1.97×10^6 erg	0.0158 J or 1.58×10^5 erg	0.0247 J or 2.47×10^5 erg
10	$y = 4 \sin 120\pi t$	$y = 2 \sin 140\pi t$	$y = 5 \sin 10\pi t$	$y = 0.2 \sin 20\pi t$	$y = 4.3 \sin 70\pi t$

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

DATA SHEET

Module M 9 SIMPLE MACHINES

Experiment 1A

Step 4 _____cm

Step 5 _____cm

Step 6 TMA = _____

Step 7 _____dynes

Step 8 _____dynes

Step 9 AMA = _____

Step 10 Eff =_____

Step 11 Input force _____ dynes

Output force _____ dynes

Input distance _____ cm

Output distance _____ cm

Step 12 Work output _____ erg

Step 13 Work input _____ erg

Step 14 Eff _____%

Step 15 _____

Experiment 1B

Step 1 _____

Step 2 _____

Step 3 _____

Step 4 _____

Step 5 _____

Experiment 2

Step 2 _____ in

Step 3 _____ in

Step 4 _____ in

Step 5 _____ in

Step 6 _____

Step 7 _____ in

Step 8 _____ in

Step 9 _____

Step 10 _____

Step 11 _____in

Step 12 _____in

Step 13 _____

Step 15 _____lb

Step 16 _____

Step 17 _____%

Experiment 2 (Continued)

Step 14

Step 18

Experiment 3

Step 1 _____

Step 2 _____

Step 3 _____

Step 4 _____

Step 5 _____

Step 6 _____

Step 7 _____

Step 8 _____

Step 9 _____

Step 10 _____

Step 11 _____

Step 12 _____

Step 13 _____

Step 14 _____

Step 15 _____

Step 16 _____

Step 17 _____

Step 18 _____

DATA SHEET "Experiment 4"

(For Electronics Students)

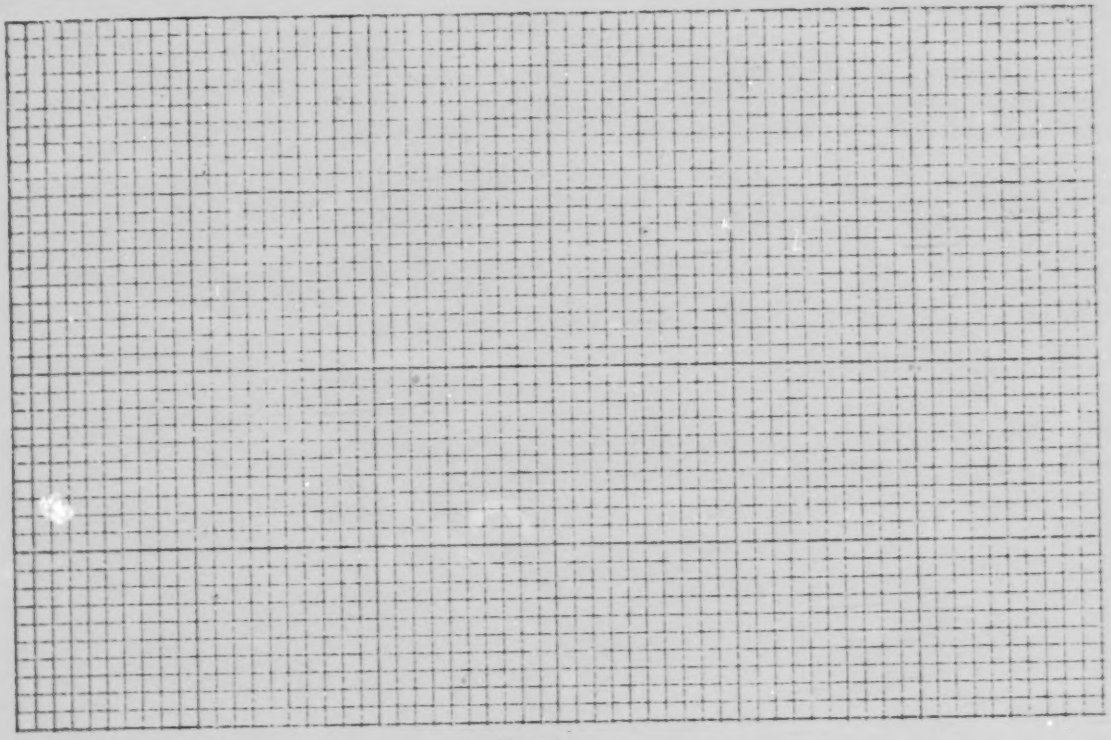
Module M 9 SIMPLE MACHINES

1 & 2. Observations:

5 & 6.

Knob Rotation (revolutions)	Dial Movement	Core Rod Movement
$\frac{1}{2}$		
1		
$1\frac{1}{2}$		
2		
$2\frac{1}{2}$		
3		
$3\frac{1}{2}$		
4		
$4\frac{1}{2}$		
5		
$5\frac{1}{2}$		
6		

7.



8. Questions:

10. Calculations and Questions:

11, 12, & 13 Observations:

14, 15, & 16 Observations:

17. Questions: a)

b)

c)

d)

21, 22, & 23 Observations:

TEST A NAME_____

Module M 9 SIMPLE MACHINES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The actual mechanical advantage of simple machines cannot be less than one.

T - F 2. The work output of a machine is always less than the work input.

T - F 3. A machine can be constructed that will decrease force and increase speed at the same time.

T - F 4. A screwjack is a modification or variation of the lever.

T - F 5. The efficiency of a machine can exceed 100% only if it is well lubricated.

6. An input force of 75 lb pulled through 25 ft on an inclined plane raises a load of 375 lb while lifting it vertically 4 ft in 15 s. The AMA is:

a) 6.25
b) 0.2
c) 5
d) 0.16

7. A third class lever is 30 cm long and lifts a load on the end. The input force is applied 6 cm from the fulcrum. The TMA is:

a) 1.25
b) 0.2
c) 6
d) 5

8. If the work output of a worm gear is 225 J and the work done against internal friction is 75 J, what is the efficiency?

a) 75%
b) 33%
c) 67%
d) cannot be calculated

9. A hydraulic jack has an input piston with a 1 cm diameter. Its output piston diameter is 6 cm. If the efficiency is 85%, what is the actual mechanical advantage?

10. The AMA of the screw on a screwjack is 5. The handle has an AMA of 14. What is the overall AMA of the jack?

TEST B NAME_____

Module M 9 SIMPLE MACHINES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The efficiency of simple machines cannot be less than 100%.

T - F 2. The work input of a machine is always less than the work output.

T - F 3. A machine can be constructed that will increase force and increase speed at the same time.

T - F 4. A wheel and axle is a modification or variation of the lever.

T - F 5. The work output of a machine is the work input minus the work done against friction.

6. A load of 300 N was lifted 1 m on a differential pulley by an input force of 40 N pulled through 10.7 m in 15 s. What is the TMA?

a) 0.13 c) 10.7
b) 7.5 d) 0.094

7. A screw jack has an average radius of 0.875 in and a pitch of 0.25 in. What is the TMA?

a) 3.5 c) 11
b) 0.29 d) 22

8. If the work output of a block and tackle is 3300 J and the input is 4800 J, what percent is lost in overcoming friction?

a) 45% c) 69%
b) 31% d) cannot be calculated

9. An inclined plane 20 ft long is used to move a load up to the loading dock from ground level, a vertical distance of 5 ft. (The angle of incline is 14°.) If 235 lb is required to slide a 500 lb crate up the incline, what is the efficiency?

10. The efficiency of two levers is 85% each. If the output force of one is used to apply the input force to the other, what is the overall efficiency?

TEST C NAME_____

Module M 9 SIMPLE MACHINES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The theoretical mechanical advantage of some simple machines can be either greater than or less than one.

T - F 2. The force output of machines can be greater than or less than the force input.

T - F 3. A little oil will usually increase the efficiency of a machine.

T - F 4. The wheel and axle is a modification or variation of the inclined plane.

T - F 5. The AMA of a machine can exceed the TMA only if it is well lubricated.

6. A load of 450 N was lifted 1.5 m vertically on an incline plane. It was pushed through a distance of 6 m by an input force of 138 N. What is the AMA?

a) 4 c) 0.31
b) 0.25 d) 3.26

7. What is the TMA of a first class lever if the input force is applied 28 cm from the fulcrum and the load is located 30.5 cm from the input force?

a) 12.2 c) 11.2
b) 1.1 d) 0.089

8. The AMA of a block and tackle is 9 and the TMA is 13. Its efficiency is:

a) 144% c) 44%
b) 69% d) cannot be calculated

9. A wheel and axle is used to hoist a 100 lb load 18 ft. If 25 lb is required on the wheel and moves through a distance of 90 ft, find the efficiency.

10. A hydraulic jack is used to apply the input force to a lever. The TMA of the jack handle is 8 and of the hydraulic mechanism is 6. What must be the TMA of the lever if the overall TMA is 240?

TEST D NAME_____

Module M 9 SIMPLE MACHINES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The actual mechanical advantage of some simple machine can be either greater than or less than one.

T - F 2. The mechanical advantage is usually expressed as a percent.

T - F 3. A little oil will usually increase the AMA of a machine.

T - F 4. The mechanical advantage of compound machines is found by multiplying the mechanical advantage of the individual components.

T - F 5. If the force output of a machine is greater than the force input, then the work output will be greater than than the work input.

6. An input force on a hydraulic jack is 38 lb. If the TMA is 7 and the AMA is 5.25, what load will be lifted?

a) 200 lb
b) 266 lb
c) 465 lb
d) 66.5 lb

7. What is the TMA of a plank 16 ft long, used as an inclined plane? It is used to push a load onto a truck bed 4.25 ft above the ground. The angle of the incline is 14.9°.

a) 68
b) 3.77
c) 0.26
d) 4.11

8. The AMA of a hydraulic jack is 7.5 and its efficiency is 90%. What is the TMA?

a) 0.12
b) 6.75
c) 8.3
d) cannot be calculated

9. A first class lever requires 140 N to lift a 600 N load. If the efficiency is 90%, what is the length of the output lever arm if the input lever arm is 20 cm?

10. A block and tackle is used to pull a crate up a ramp. If the ramp (inclined plane) has an AMA of 2 and the block and tackle has an AMA of 7, what is the overall AMA?

TEST E NAME_____

Module M 9 SIMPLE MACHINES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The efficiency fo simple machines cannot be greater than 100%.

T - F 2. The TMA of a machine is always less than the AMA.

T - F 3. A little oil will usually increase the TMA of a machine.

T - F 4. The mechanical advantage of compound machines is found by adding the mechanical advantage of the individual components.

T - F 5. A third class lever has a greater force input than output. A second class lever is just the opposite. This does not mean the efficiency of one is greater than the other.

6. The input force on a differential pulley is pulled through a distance of 46 ft. If the TMA is 6 and the AMA is 4.25, how high will the load be lifted?

a) 276 ft
b) 7.7 ft
c) 10.8 ft
d) 196 ft

7. A wheel is 16 in in diameter. An axle, attached rigidly to the wheel is 2 in in diameter. The axle is 4.25 cm long. What is the TMA of the wheel and axle?

a) 2.66
b) 0.125
c) 21.3
d) 8

8. If the work input to a screw jack is 675 J and the work done against internal friction is 400 J, what is the efficiency?

a) 41%
b) 59%
c) 63%
d) cannot be calculated

9. A block and tackle requires an 85 N input to lift a 600 N load. If the theoretical mechanical advantage is 9, what is the efficiency?

10. A wheel and axle is used as a hoist to pull a crate up a ramp. The ramp (inclined plane) has an efficiency of 50%. The wheel and axle has an AMA of 7 and a TMA of 9. What is the efficiency of the combination wheel and axle and ramp?

TEST ANSWER KEYS

Module M 9 SIMPLE MACHINES

PROBLEM	A	B	C	D	E
1	F	F	T	T	T
2	T	F	T	F	F
3	T	F	T	T	F
4	F	T	F	T	F
5	F	T	F	F	T
6	c	c	d	a	b
7	b	d	c	b	d
8	a	b	b	c	a
9	30.6	53%	80%	4.2 cm	78%
10	70	72%	5	14	39%

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

DATA SHEET

Module M 2 SIZING THINGS UP

Experiment A Linear Measurement

Object	Estimate	Measure	Error
1. Diameter of cylinder 2. Length of cylinder			
3. Diameter of glass ball 4. Length of Nickel plate			
5. Width of Nickel plate 6. Length of blue spaghetti			
7. Length of conductor 8. Length of ground wire			
9. Length of this sheet of paper 10. Width of this sheet of paper			
11. Your height			
12. Length of table top (nearest m) 13. Width of table top (nearest m)			
14. Length of room (nearest m) 15. Width of room (nearest m)			
16. Area of this sheet of paper	XXXXXXX		XXXXXXX
17. Area of table top	XXXXXXX		XXXXXXX
18. Area of room	XXXXXXX		XXXXXXX

Experiment B Precision Measurement

Object	Distance	Micrometer	Vernier
1. Sphere 2. Small cylinder	Diameter Diameter		
3. Small cylinder 4. Large cylinder	Length Outside diameter		
5. Large cylinder 6. Large cylinder	Inside diameter Length	XXXXXXXXX XXXXXXXXX	
7. Large cylinder 8. Block	Depth of hole Length	XXXXXXXXX XXXXXXXXX	
9. Block 10. Block	Width Height		

CONTINUED

Experiment B (Continued)

11. Calculate the volume of the sphere	
12. Calculate the volume of the small cylinder	
13. Calculate the volume of the block	

Experiment C Volume Measurement

Object	Estimate	Measure	Error
1. Teaspoon 2. Tablespoon			
3. Cup (measuring) 4. Brown bottle (fl oz)			
5. Medium Lederlie (plastic) 6. Large Lederlie (plastic			
7. Lilly (plastic) 8. Upjohn (plastic)			

Experiment D Mass Measurement

Object	Measure
1. Brass cylinder 2. Aluminum cylinder	
3. Steel "U" 4. Push button switch	
5. Resistor (Dale) 6. Small coil (600)	
7. Rheostat (Ohmite) 8. Capacitor (Astron)	
9. Calculate your weight in kilograms	
10. Your weight (bathroom scale)	

Experiment E Density Measurement

Quantity	side 1	side 2	side 3	side 4	average
1. Length					
2. Width					
3. Height					

4. Calculated volume of the block	
5. Mass of the block	
6. Calculated density of the block	
7. Density of the block (table 4, page 19)	
8. Percentage error	

DATA SHEET

Module M 2 SIZING THINGS UP

Experiment A Linear Measurement

Object	Estimate	Measure	Error
1. Diameter of cylinder or disc 2. Length of cylinder or disc			
3. Diameter of plastic ball 4. Length of aluminum plate			
5. Width of aluminum plate 6. Length of polyethylene			
7. Length of machine bolt 8. Length of band saw segment			
9. Length of this sheet of paper 10. Width of this sheet of paper			
11. Your height			
12. Length of table top (nearest m) 13. Width of table top (nearest m)			
14. Length of room (nearest m) 15. Width of room (nearest m)			
16. Area of this sheet of paper			
17. Area of table top			
18. Area of room			

Experiment B Precision Measurement

Object	Distance	Micrometer	Vernier
1. Sphere 2. Small cylinder	Diameter Diameter		
3. Small cylinder 4. Large cylinder	Length Outside diameter		
5. Large cylinder 6. Large cylinder	Inside diameter Length	XXXXXXXXX XXXXXXXXX	
7. Large cylinder 8. Block	Depth of hole Length	XXXXXXXXX XXXXXXXXX	
9. Block 10. Block	Width Height		

CONTINUED

Experiment B (Continued)

11. Calculate the volume of the sphere	
12. Calculate the volume of the small cylinder	
13. Calculate the volume of the block	

Experiment C Volume Measurement

Object	Estimate	Measure	Error
1. Teaspoon 2. Tablespoon			
3. Cup (measuring) 4. Brown bottle (fl oz)			
5. Medium Lederlie (Plastic) 6. Large Lederlie (Plastic)			
7. Lilly (plastic) 8. Upjohn (plastic)			

Experiment D Mass Measurement

Object	Measure
1. Plastic gear 2. Plastic cylinder	
3. Steel plate 4. Steel hollow cylinder	
5. Square tubing 6. Stove bolt	
7. Calculate your weight in kilograms	
8. Your weight (bathroom scale)	

CONTINUED

TEST A

Module M 2 SIZING THINGS UP

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, on separate paper, write the problem number followed by the letter you chose. Be sure to include your name, module number and test number, for example: John Doe, M 2 - A, as a heading.

T - F 1. The three fundamental quantities adopted for mechanics in a gravitational measuring system are time, weight and distance.

T - F 2. The prefix meaning 10^3 is kilo and its abbreviation is the small case letter k.

T - F 3. Accuracy is a term that can be applied to the metric system but not the British.

T - F 4. A cubic meter is more than 30% larger than a cubic yard.

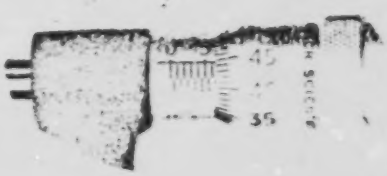
T - F 5. An equivalent of 75 mi/h is 100 ft/s.

6. The density of mercury is 13.6 g/cm^3. Its value in pounds per gallon is
   a) 8.33 c) 848
   b) 113 d) 23.3

7. Momentum is defined as: momentum = mass x velocity, and velocity = distance/time. The fundamental unit of momentum in the mks measuring system is
   a) s/kg·m c) kg·s/m
   b) kg·m/s d) m/kg·s

8. The reading of the vernier caliper in centimeters is
   a) 3.01 c) 3.51
   b) 3.41 d) 4.40

9. The reading of the micrometer caliper in millimeters is
   a) 5.946 c) 6.946
   b) 6.446 d) 5.446



10. How many watts is 82.4 kW?
    a) 82 400 c) 82 400 000
    b) 0.0824 d) 0.0000824

11. Which of the following is the largest?
    a) 25 liters c) 1 000 cubic inches
    b) 5 gallons d) 1 cubic foot

12. The speed of an electric wave in a transmission line is 2.1×10^8 m/s. Express this speed in miles per hour.

TEST B

Module M 2 SIZING THINGS UP

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, on separate paper, write the problem number followed by the letter you chose. Be sure to include your name, module number and test number (letter), for example: John Doe, M 2 - B, as a heading.

T - F 1. The three fundamental quantities adopted for mechanics in a gravitational measuring system are time, distance and mass.

T - F 2. The prefix meaning 1000 is kilo and its abbreviation is the capital letter K.

T - F 3. Accuracy is a term that can be applied to both the metric and British measuring systems.

T - F 4. A cubic yard is less than 80% of a cubic meter.

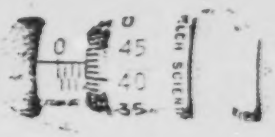
T - F 5. An equivalent of 75 mi/h is 110 ft/s.

6. The density of battery acid is 1.3 g/cm^3. Its value in pounds per gallon is
   a) 10.8 c) 8.33
   b) 13.6 d) 6.41

7. The formula for force is: force = mass x acceleration, and acceleration = distance/(time)^2. The fundamental unit of force in the mks measuring system is
   a) $s^2/kg \cdot m$ c) $kg \cdot s^2/m$
   b) $kg \cdot m^2/s$ d) $kg \cdot m/sec^2$

8. The reading of the vernier caliper in centimeters is
   a) 3.07 c) 2.27
   b) 2.17 d) 2.07

9. The reading of the micrometer caliper in millimeters is
   a) 4.426 c) 3.926
   b) 3.426 d) 2.926



10. How many microohms is 5.94 MΩ?
    a) 5.94×10^{-12} c) 5.94×10^{6}
    b) 5.94×10^{-6} d) 5.94×10^{12}

11. Which of the following is the largest?
    a) 0.01 cubic feet c) 0.3 gallons
    b) 231 cubic inches d) 3.1 liters

12. The speed of an electric wave in a transmission line is 2.1×10^8 m/s. Express this speed in feet per second.

TEST C

Module M 2 SIZING THINGS UP

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, on separate paper, write the problem number followed by the letter you chose. Be sure to include your name, module number and test number (letter), for example: John Doe, M 2 - C, as a heading.

T - F 1. The three fundamental quantities adopted for mechanics in an absolute measuring system are time, weight and distance.

T - F 2. The prefix meaning one million is micro and its abbreviation is the small case Greek letter μ.

T - F 3. Accuracy generally refers to the reliability of measuring instruments.

T - F 4. A quart is about 6% larger than a liter.

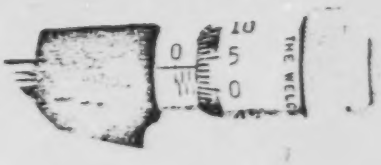
T - F 5. An equivalent of 66 ft/s is 45 mi/h.

6. Aluminum sheet metal (0.08 mm thick) has an area density of 0.221 grams per square centimeter. The equivalent in pounds per square foot is
   a) 0.000487 c) 0.453
   b) 7.24 d) 4.43

7. Work is defined as: work = force x distance, force = mass x acceleration, and acceleration = distance/(time)^2. The fundamental unit of work in the mks measuring system is
   a) $kg \cdot m^2/s^2$ c) $kg^2 \cdot m/s^2$
   b) $kg \cdot s^2/m^2$ d) $m^2/kg \cdot s^2$

8. The reading of the vernier caliper in inches is
   a) 0.68 c) 1.05
   b) 0.55 d) 0.58

9. The reading of the micrometer caliper in millimeters is
   a) 2.037 c) 2.537
   b) 3.537 d) 3.037



10. How many amperes is 3 100 mA?
    a) 3 100 000 c) 3.1
    b) 3 100 000 000 d) 0.0031

11. Which of the following is the largest?
    a) 5 000 milliliters c) 0.08 cubic feet
    b) 4.5 quarts d) 231 cubic inches

12. The speed of an electric wave in a transmission line is 13 000 mi/s. Express this speed in meters per second.

TEST D

Module M 2 SIZING THINGS UP

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, on separate paper, write the problem number followed by the letter you chose. Be sure to include your name, module number and test number, for example: John Doe, M 2 - D, as a heading.

T - F 1. The three fundamental units adopted for mechanics in the mks measuring system are the second, kilogram, and meter.

T - F 2. The prefix meaning one thousandth is micro and its abbreviation is the small case Greek letter mu (μ).

T - F 3. A measurement such as 56.6 means the true value lies somewhere between 56.55 and 56.65.

T - F 4. One mile is about 60% greater than a kilometer.

T - F 5. An equivalent of 18 000 W·s is 5 kW·h

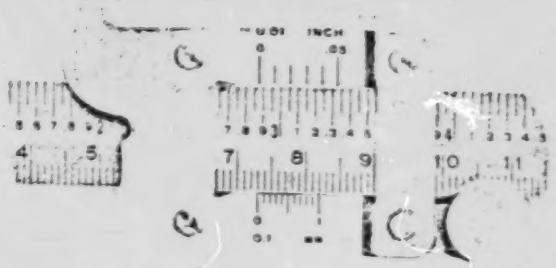
6. Aluminum sheet metal (0.08 mm thick) has an area density of 0.453 lb/ft^2. In grams per square centimeter, this would be:

a) 2.65 c) 0.441
b) 0.0441 d) 0.221

7. Impulse is defined as: Impulse = force x time, Force = mass x acceleration and acceleration = distance/$(time)^2$. The fundamental unit of impulse in the mks system is:

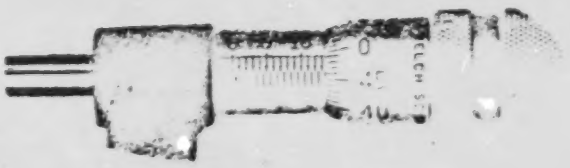
a) m·s/kg c) kg·s/m
b) kg·m/s d) s/kg·m

8. The reading of the vernier in centimeters is:



a) 8.78 c) 7.01
b) 8.20 d) 7.31

9. The reading of the micrometer caliper in millimeters is:



a) 13.008 c) 13.492
b) 13.992 d) 13.508

10. How many microhenries is 495 mH?

a) 4.95×10^{-5} c) 4.95×10^{-1}
b) 4.95×10^{5} d) 4.95×10^{2}

11. Which of the following is the largest?

a) 5 ft^3 c) 120 l
b) 30 gal d) 6250 in^3

12. Radio waves travel at a speed of 3×10^8 m/s. Express this in miles per hour.

TEST E

Module M 2 SIZING THINGS UP

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, on separate paper, write the problem number followed by the letter you chose. Be sure to include your name, module number and test number, for example: John Doe, M 2 - E, as a heading.

T - F 1. The three fundamental units adopted for mechanics in the cgs measuring system are second, gram, and meter.

T - F 2. The prefix meaning 10^{-6} is micro and its abbreviation is the small case Greek letter mu (μ).

T - F 3. A measurement such as 74.7 means the true value is between 74.6 and 74.8 and cannot be determined with less uncertainty.

T - F 4. A kilometer is about 40% less than a mile.

T - F 5. An equivalent of 54 000 000 W·s is 15 kW·h.

6. An electrical ground strap has a <u>length</u> density of 1.11 g/cm. Its density in pounds per foot is:

a) 0.0746 c) 0.00374
b) 1.00 d) 1.492

7. Pressure is defined as: Pressure = Force/area and Force = mass x acceleration, Acceleration = distance/$(\text{time})^2$, and Area = $k(\text{distance})^2$ The fundamental unit of pressure in the mks system is:

a) lb/in^2 c) $kg \cdot m^4/s^2$
b) $kg/m \cdot s^2$ d) $kg \cdot s^2/m^2$

8. The reading of the vernier caliper in millimeters is:

a) 83.9 c) 82.9
b) 80.9 d) 92.0

9. The reading of the micrometer caliper in millimeters is:

a) 13.841 c) 13.341
b) 12.841 d) 14.341

10. An equivalent of 500 mV is how many kilovolts?

a) 5×10^{-4} c) 5×10^{-1}
b) 5×10^{8} d) 5×10^{5}

11) Which of the following is the largest?

a) 2000 gal c) 10 yd^3
b) 275 ft^3 d) 8 m^3

12. Radio waves travel at 186 000 mi/s. Express this speed in meters per second.

TEST ANSWER KEYS

Module M 2

SIZING THINGS UP

PROBLEM	A	B	C	D	E
1	T	F	F	T	F
2	T	F	F	F	T
3	F	T	T	T	F
4	T	T	F	T	T
5	F	T	T	F	T
6	b	a	c	d	a
7	b	d	a	b	b
8	c	b	d	d	c
9	b	c	d	c	c
10	a	d	c	b	a
11	d	b	a	a	d
12	4.7×10^8 mi/h	6.89×10^8 ft/s	2.09×10^8 m/s	6.70×10^8 mi/h	2.98×10^9 m/s

GRADING

NUMBER WRONG	GRADE
0	100
1	92
2	83
3	75
4	67
5	59
6	50

DATA SHEET

Module W 3 SOUND SOURCES

Step 1 _____ °C

Step 2 _____ cm

Steps 7 through 10

Position number (n)	Position (L_n)	Wavelength (λ)
1	_____ cm	_____ m
2	_____ cm	_____ cm
3	_____ cm	_____ cm
4	_____ cm	_____ cm
5	_____ cm	_____ cm
6	_____ cm	_____ cm
7	_____ cm	_____ cm
8	_____ cm	_____ cm
	Average	_____ cm

Frequency _____ Hz

Step 11 _____ m/s

Step 12 _____ m/s

Step 13 Difference _____ %

NAME_____

TEST A

Module W 3 SOUND SOURCES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Resonance can occur to some degree when the vibration frequency of one object is an integer multiple of that of the resonating body.

T - F 2. The lowest frequency of the standing waves in a stretched wire is called the fundamental.

T - F 3. When there is relative motion between an observer and a source of waves, there appears to be a higher or lower pitch than usual.

T - F 4. The second overtone of an open pipe is the 2nd harmonic.

T - F 5. As a train speeds up while approaching a station, the pitch of its whistle decreases to an observer at the station.

6. A closed pipe emits a fundamental frequency of 23.7 Hz. The 1st overtone has a frequency of

a) 23.7 c) 71.1 Hz

b) 47.4 Hz d) 118.5 Hz

7. An open pipe emits a 2nd overtone of 94.8 Hz. The 3rd overtone frequency is:

a) 31.6 Hz c) 132.7 Hz

b) 94.8 Hz d) 126.4 Hz

8. A sound source vibrates at 100 Hz and is receding from an observer with a speed of 38 m/sec. If the speed of sound is 332 m/sec, what frequency does the observer hear? (Calculate carefully).

a) 89.8 Hz c) 111.5 Hz

b) 113 Hz d) 88.5 Hz

OVER

9. A radar transmitter sends out a wave with a frequency of 0.1 GHz. A car is approaching at a speed of 28.5 m/s. How many beats does the radar set observe? ($c = 3 \times 10^8$ m/s)

10. A source vibrating with a frequency of 10 Hz sets up standing waves on a string. The antinodes are 10 cm apart. What is wave velocity?

11. A bathroom with 1 x 3 x 2.5 m dimension is entirely covered with tile (sound-absorption coefficient is 0.03). It has 3 m^2 of plastic curtain (coefficient is 0.20). What is the reverberation time?

12. The reverberation time of a room is 1 s. If the intensity level of sound in the room is 75 db, what will it be 1 s after the sound source is turned off?

NAME_____

TEST B

Module W 3 SOUND SOURCES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Resonance can occur when the frequency of vibration of one object is the same as the fundamental of the resonating body.

T - F 2. The first overtone of any sounding body is always the first harmonic.

T - F 3. When there is relative motion between an observer and a source of waves, there appears to be a higher or lower amplitude than usual.

T - F 4. The third overtone of a closed pipe is the 4th harmonic.

T - F 5. As a train slows down after passing a station, the pitch of its whistle increases to an observer at the station.

6. A closed pipe emits a fundamental frequency of 23.7 Hz. The 3rd overtone has a frequency of

a) 23.7 Hz c) 118.5 Hz

b) 71.1 Hz d) 165.9 Hz

7. A vibrating string emits a 1st overtone of 94.8 Hz. The 2nd harmonic is:

a) 284.4 Hz c) 189.6 Hz

b) 94.8 Hz d) 474.0 Hz

8. A stationary sound source vibrates at 100 Hz and an observer is moving toward it at 38 m/sec. If the speed of sound is 332 m/sec, what frequency does the observer hear? (Calculate carefully).

a) 89.8 Hz c) 111.5 Hz

b) 113 Hz d) 88.5 Hz

OVER

9. A radar transmitter sends out a wave with a frequency of 95 MHz. A car is approaching at a speed of 31.6 m/s. How many beats does the radar set observe? ($c = 3 \times 10^8$ m/s)

10. A source vibrating with a frequency of 25 Hz sets up standing waves on a string. The distance from node to antinode is 25 cm. What is the wave velocity?

11. A small shel 2 x 2 x 3 m dimensions is entirely made of wood (sound-absorption coefficient is 0.05). Two people (1 m^2 each) are in the shed (coefficient is 0.50). What is the reverberation time?

12. The intensity of sound in a room is $7.5 \times 10^{-10} W/m^2$. What will it be if the intensity level increases by 50 db?

NAME_____

TEST C

Module W 3 SOUND SOURCES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Resonance will always occur when the amplitude of vibration of one object is an intger multiple of the other.

T - F 2. The fundamental of any sounding body is always the first harmonic.

T - F 3. When the distance between an observer and a source of sound decreases,the pitch seems higher than usual (no acceleration).

T - F 4. The third overtone of a closed pipe is the 7th harmonic.

T - F 5. As a train speeds up after passing a station, the pitch of its whistle increases to an observer at the station.

6. A closed pipe emits a fundamental frequency of 50 Hz. The first overtone has a frequency of

a) 50 c) 150

b) 100 d) 200

7. A vibrating string emits a 3rd harmonic of 189.6 Hz. The second overtone frequency is:

a) 379.2 Hz c) 94.8 Hz

b) 948 Hz d) 189.6 Hz

8. A sound source vibrates at 100 Hz and is approaching an observer with a speed of 38 m/sec. If the speed of sound is 332 m/sec, what frequency does the observer hear? (Calculate carefully).

a) 89.8 Hz c) 111.5 Hz

b) 113 Hz d) 88.5 Hz

OVER

9. A radar transmitter sends out a wave with a frequency of 105 MHz. An airplane is approaching at a speed of 142 m/s. How many beats does the radar set observe? ($c = 3 \times 10^8$ m/s).

10. A source vibrating with a frequency of 60 Hz sets up standing waves on a string. The wave velocity is 30 m/s. How far apart are successive nodes?

11. A bathroom with 1 x 3 x 2.5 m dimensions is entirely covered with tile (sound-absorption coefficient is 0.03). One person (1 m^2) is in the room (coefficient of a person without clothes is 0.25). What is the reverberation time?

12. The intensity level of sound in a room is 20 db. If the intensity of the sound increases by a factor of 100 000 000, what is the new intensity level?

NAME _____

TEST D

Module W 3 SOUND SOURCES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. When small impulses are applied to an object at the natural frequency of the object, a large amplitude of vibration can be built up in the object.

T - F 2. The shortest wavelength of the standing waves produced by a stretched wire is the fundamental.

T - F 3. When the distance between an observer and a source of sound increases, the frequency seems higher than usual (no acceleration).

T - F 4. The second overtone of a closed pipe is the 3rd harmonic.

T - F 5. As a train speeds up while approaching a station, the pitch of its whistle increases to an observer at the station.

6. A closed pipe emits a 1st overtone frequency of 75 Hz. The fundamental frequency is:

a) 25 Hz c) 50 Hz

b) 37.5 Hz d) 75 Hz

7. An open pipe emits a 5th overtone of 900 Hz. The fundamental frequency is:

a) 180 Hz c) 300 Hz

b) 150 Hz d) 450 Hz

8. An observer moves away from a sound source vibrating at 100 Hz with a speed of 52 m/sec, (Source is stationary). If the speed of sound is 332 m/sec, what frequency does the observer hear? (Calculate carefully).

a) 86.5 Hz c) 116 Hz

b) 119 Hz d) 84.3 Hz

OVER

9. A radar transmitter sends out a wave with a frequency of 110 MHz. An airplane is approaching and the beat frequency observed (electronically) is 110 beats/s. What is the velocity of approach? ($c = 3 \times 10^8$ m/s).

10. A vibrating source sets up standing waves on a string. The wave velocity is 20 m/s. If successive nodes are 25 cm apart, what is the frequency of the source?

11. A small shed 2 x 3 x 2 m dimensions is entirely made of wood (sound-absorption coefficient is 0.05). One person (1 m^2) is in the shec (coefficient is 0.50). What is the reverberation time?

12. The intensity level of sound in a room is 80 db. If the intensity of the sound drops by a factor of 100 000, what is the new intensity level?

NAME_____

TEST E

Module W 3 SOUND SOURCES

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. A high frequency can be built up in one body by another in resonance with it by a series of perfectly times impulses.

T - F 2. The highest frequency of the standing waves produced by a stretched wire is the fundamental.

T - F 3. When the distance between an observer and a source of sound decreases, the frequency seems lower than usual (no acceleration).

T - F 4. The fourth overtone of an open pipe is the 5th harmonic.

T - F 5. As a train speeds up after passing a station, the pitch of its whistle decreases to an observer at the station.

6. A closed pipe emits a 2nd overtone frequency of 750 Hz. The fundamental frequency is:

a) 150 Hz c) 107 Hz

b) 250 Hz d) 375 Hz

7. An open pipe emits a 3rd harmonic of 900 hz. The 1st overtone frequency is:

a) 300 Hz c) 600 Hz

b) 450 Hz d) 900 Hz

8. A sound source vibrates at 100 Hz and is moving toward an observer with a speed of 52 m/sec. If the speed of sound is 332 m/sec, what frequency does the observer hear? (Calculate carefully).

a) 86.5 Hz c) 116 Hz

b) 119 Hz d) 84.3 Hz

OVER

9. A radar transmitter sends out a wave with a frequency of 95 MHz. A car is approaching and the beat frequency observed (electronically) is 14 beats/s. What is the velocity of approach? ($c = 3 \times 10^8$ m/s).

10. A vibrating source sets up standing waves on a string. The wave velocity is 25 m/s. If the frequency of the source is 40 Hz, how far apart are successive nodes?

11. A small room with a 3 x 4 x 2.5 m dimensions is covered with heavy drapes on all four walls and a heavy carpet on the floor (sound-absorption coefficient for both is 0.50). It has an acoustic ceiling with a coefficient of 0.50. What is the reverberation time?

12. The intensity of sound in a room is 3.7×10^{-4} W/m . What will it be if the intensity level drops by 70 db?

TEST ANSWER KEYS

Module W 3 SOUND SOURCES

PROBLEM	A	B	C	D	E
1	T	T	F	T	F
2	T	F	T	F	F
3	T	F	T	F	F
4	F	F	T	F	T
5	F	T	F	T	T
6	c	d	c	a	a
7	d	b	d	b	c
8	a	c	b	d	b
9	19 beats/s	20 beats /s	99.4 beats/s	150 m/s	22.1 m/s
10	2 m/s	25 m/s	25 cm	40 Hz	31.5 cm
11	0.93 s	0.74 s	1.2 s	0.91 s	0.16 s
12	15 db	7.5×10^{-5} W/m^2	100 db	30 db	3.7×10^{-11} W/m^2

GRADING

NUMBER WRONG	GRADE
0	100
1	92
2	83
3	75
4	67
5	58
6	50

DATA SHEET

Module M 4 STATIC EQUILIBRIUM

Step 1 Weight of knife-edge clamps _____ g

Step 8 Spring scale readings _____ g, _____ g

Steps 6, 9 and 10

	Force	Location
R_1		
R_2		
A	100 g	
B	100 g	
C	50 g	

Note: The reactions R_1 and R_2 are the spring balance reading minus the weight of the knife-edge clamp.

Step 11 Calculated location of center of gravity _____ cm

Step 11 Calculated weight of meter stick-slotted weight combination

_____ g

Step 15 Measured location of center of gravity _____ cm

Step 13 Measured weight of meter stick-slotted weight combination

_____ g

Step 14 Percentage difference in calculated and measured weight _____ %

Step 16 Difference in calculated and measured location of c.g. _____ mm

Calculations:

NAME_____

TEST A

Module M 4 STATIC EQUILIBRIUM

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The magnitude of a moment of force depends on how far its line of action is from the fulcrum.

T - F 2. A group of parallel forces are usually said to be concurrent.

T - F 3. The algebraic sum of the forces acting on an object in equilibrium must be equal to zero.

T - F 4. It is possible for an object to be in linear equilibrium but not rotational equilibrium at the same time.

T - F 5. The lever arm of a force is the perpendicular distance from the fulcrum to the line of action of the force.

6. The unit of torque in the mks measuring system is:

a) m/N c) $N \cdot m$
b) $m \cdot N^2$ d) N/m

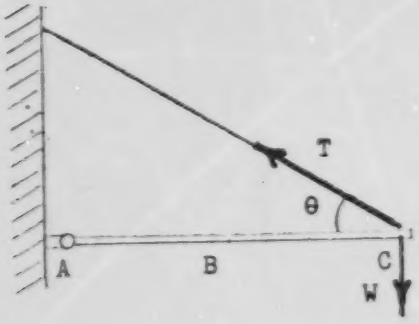
7. Which of the following group of parallel forces cannot be in equilibrium?

a) 28, 56, 84 lb c) 156, 156, 312 oz
b) 17, 18, 35 N d) 19, 36, 56 ton

8. A uniform beam is 5 m long and weighs 400 kg. It has a load of 500 kg attached at one end. The balance point (measured from the loaded end) in centimeters is:

a) 563 c) 111
b) 222 d) 313

9. A uniform plank weighing 75 lb is 14 ft long. A 175 lb painter stands at the 9 ft mark and a 5 gal paint can weighing 42 lb is at the 5 ft mark. What are the tensions in the ropes that support the plank at each end?

10. 

A 100 lb horizontal bar (AB) is 10 ft long and has its center of gravity at B, 4 ft from pin A. A weight of 500 lb is located at C on the end of the bar. The angle is 55°. Find the tension T in the cable (CD).

NAME_____

TEST B

Module M 4 STATIC EQUILIBRIUM

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The moment of force is the magnitude of the force times its direction.

T - F 2. A group of non-parallel forces are always concurrent.

T - F 3. The vector sum of the forces acting on an object in equilibrium does not need to equal zero if the vector sum of the moments equal zero.

T - F 4. It is possible for an object to be in rotational equilibrium but not linear equilibrium at the same time.

T - F 5. The lever arm of a force is the perpendicular distance from the center of gravity to the line of action of the force.

6. The unit of torque in the cgs measuring system is:

a) dyne·cm c) cm/dyne
b) dyne/cm d) dyne·cm^2

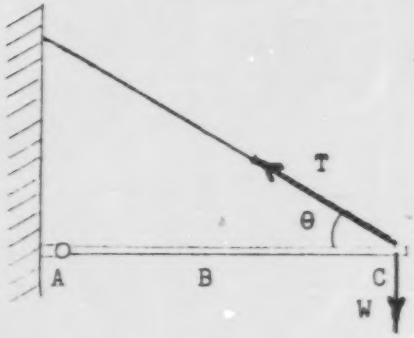
7. Which of the following group of parallel forces cannot be in equilibrium?

a) 1, 2, 3 dynes c) 1, 1, 2 ton
b) 3, 4, 5 d) 5, 5, 10 lb

8. A uniform steel rod is 16 ft long and weighs 900 lb. It has a load of 1200 lb attached at one end. The balance point (measured from the loaded end) in inches is:

a) 72 c) 54.9
b) 41.1 d) 96

9. A scaffold consisting of a 92 lb, 16 ft plank has a 185 lb man standing on it at the 10 ft mark. Some cement blocks located at the 14 ft mark weigh 260 lb. What are the reactions at each end?

10. 

A 700 lb horizontal bar (AB) is 15 ft long and has its center of gravity at B, 6 ft from pin A. A weight of 2500 lb is located at C on the end of the bar. The angle is 70°. Find the tension (T) in the cable (CD).

NAME_____

TEST C

Module M 4 STATIC EQUILIBRIUM

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

T - F 1. The moment of force is the force times its moment arm.

T - F 2. A group of non-parallel forces could be, but are not necessarily concurrent.

T - F 3. The vector sum of the torques acting on an object in equilibrium must be equal to zero.

T - F 4. The center of gravity is a point at which the entire weight of an object can be considered to be concentrated for the purpose of calculating moments.

T - F 5. The lever arm of a force is the distance from the fulcrum to the point where the force is applied.

6. The defining formula for moment of force is:

a) Force x moment arm
b) Force ÷ moment arm
c) Moment arm ÷ force
d) Force x (moment arm)^2

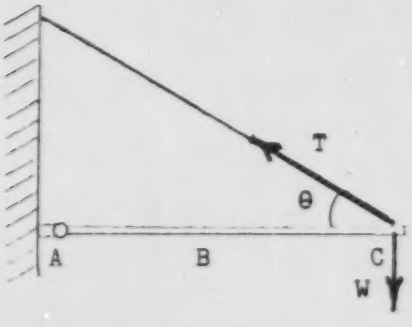
7. Which of the following group of parallel forces can be in equilibrium?

a) 1, 2, 3 lb
b) 7, 5, 10 N
c) 4, 8, 6 oz
d) 28, 46, 84 dynes

8. A uniform beam is 12 ft long and weighs 1000 lb. It has a load of 1600 lb attached at one end. The balance point (measured from the loaded end in inches is:

a) 72
b) 44.3
c) 35
d) 27.7

9. A 56 ft, 500 lb utility pole has its center of gravity 18.5 ft from the heavy end and rests on supports at each end. Two 185 lb men are standing at 15 ft and 30 ft from the heavy end. What are the reactions at each end?

10. 

A 60 kg horizontal bar (AB) is 4 m long and has its center of gravity at B, 1.25 m from pin A. A weight of 300 kg is located at C on the end of the bar. The angle is 60°. Find the tension (T) in the cable (CD).

NAME_____

TEST D

Module M 4 STATIC EQUILIBRIUM

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

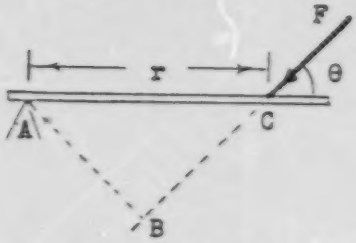
T - F 1. Torque is the product of a force and its lever arm.

T - F 2. A group of non-concurrent forces could be, but are not necessarily parallel.

T - F 3. "The vector sum of the forces acting on an object must be equal to zero," is the only condition necessary for equilibrium.

T - F 4. The center of gravity of an object must be located within the material that makes up the object.

T - F 5. The Greek capital letter sigma (Σ) represents a mathematical summation.

6. 

The formula for torque (see diagram) is:

a) Fr
b) Fr cos θ
c) Fr tan θ
d) Fr sin θ

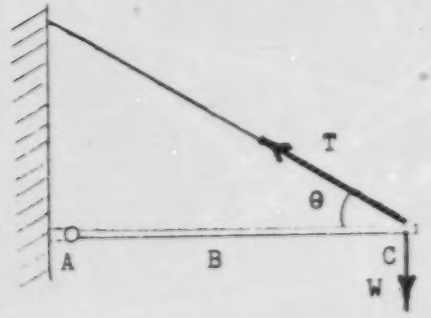
7. Which of the following group of parallel forces can be in equilibrium?

a) 156, 58, 214 dynes
b) 65, 87, 162 tan
c) 37, 129, 156 lb
d) 93, 139, 222 N

8. A uniform steel rod is 36 in long and weighs 60 lb. It has a load of 150 lb attached at one end. The balance point (measured from the loaded end) in inches is:

a) 18
b) 25.7
c) 5.14
d) 7.2

9. A uniform plank weighing 105 lb is 16 ft long. A 185 lb painter stands at the 10 ft mark and a 5 gal paint can weighing 55 lb is at the 6 ft mark. What are the tensions in the ropes that support the plank at each end?

10. 

A 150 N horizontal bar (AB) is 2 m long and has its center of gravity at B, 75 cm from pin A. A weight of 400 N is located at C on the end of the bar. The angle is 50°. Find the tension (T) in the cable (CD).

NAME_____

TEST E

Module M 4 STATIC EQUILIBRIUM

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10, circle your final answer. Be sure to include your name in the space provided.

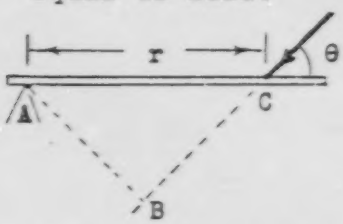
T - F 1. Torque and lever arm are other names for moment of force and moment arm, respectively.

T - F 2. A group of non-concurrent forces are always parallel.

T - F 3. "The vector sum of a set of concurrent forces acting on an object must be equal to zero," is the only condition necessary for equilibrium.

T - F 4. The center of gravity of an object is a point that doesn't necessarily reside within the material that makes up the object.

T - F 5. A body in static equilibrium must have the vector sum of all forces equal to zero and the vector sum of all torques equal to zero.

6. 

The formula for lever arm (see diagram) is:

a) r c) r cos θ
b) r sin θ d) r tan θ

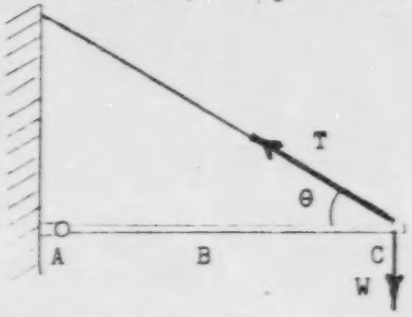
7. Which of the following groups of parallel forces can be in equilibrium?

a) 10, 11, 12 dynes c) 1, 1, 2 ton
b) 2, 3, 4 lb d) 5, 10, 20 N

8. A steel rod is 75 cm long and weighs 100 g. It has a load of 75 g attached at one end. The balance point (measured from the loaded end) in centimeters is:

a) 16.1 c) 50
b) 37.5 d) 21.4

9. A scaffold consisting of a 126 lb, 16 ft plank has a 175 lb man standing on it at the 6 ft mark. Cement blocks located at the 12 ft mark, weigh 280 lb. What are the reactions at the two ends?

10. 

A 75 lb horizontal bar (AB) is 8 ft long and has its center of gravity at B, 3 ft from pin A. A weight of 200 lb is located at C on the end of the bar. The angle θ is 45°. Find the tension (T) in the cable (CD).

TEST ANSWER KEYS

Module M 4 STATIC EQUILIBRIUM

PROBLEM	A	B	C	D	E
1	T	F	T	T	T
2	F	F	T	T	F
3	F	F	T	F	T
4	T	T	T	F	T
5	T	F	F	T	T
6	c	a	a	d	b
7	d	b	a	a	c
8	c	b	d	c	d

	A	B	C	D	E
9.	165,127 lb	389,148 lb	314,556 lb	188,154 lb	339,242 lb
10	659 lb	2958 lb	368 kg	596 N	323 lb

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

DATA SHEET

Module T 1 TEMPERATURE AND THERMAL EXPANSION

Step 7

Left caliper_____mm
Right caliper_____mm
Length of rod_____mm

Step 14 and 16

Initial temperature_____°C
Final temperature _____°C
Change in temperature_____C°

Step 13 and 16

Initial indicator reading_____mm
Final indicator reading _____mm
Change in length _____mm

Step 18

Coefficient of expansion _____1/C°

Step 19

Material rod is made of_____

Calculations:

NAME _____

TEST A

Module T 1 TEMPERATURE AND THERMAL EXPANSION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Thermal equilibrium exists between two bodies when their temperatures are the same.

T - F 2. An isobaric expansion process is one in which volume does not change.

T - F 3. Absolute zero may be thought of as the temperature all matter changes to liquid.

T - F 4. Water has its maximum density at 4°C.

T - F 5. The density of an object increases when the temperature is lowered because this increases the volume.

Match the following (6,7 and 8):

____	6	Summer	a) 10°C
____	7	Fall	b) 250 K
____	8	Winter	c) 555°R

9. The temperature of a 24 cm aluminum rod is 35°C. How much will the length increase in centimeters when the temperature is raised to 100°C? The coefficient of linear expansion is $24 \times 10^{-6}/C°$.

a) 3.7 c) 0.037

b) 0.00114 d) 0.37

10. An automobile tire has a gauge pressure of 30 lb/in^2 when the temperature is 20°C. After driving at high speed on hot pavement, the temperature increases to 70°C. Find the new gauge pressure assuming an isochoric process (atmospheric pressure is 14.7 lb/in^2).

NAME_____

TEST B

Module T 1 TEMPERATURE AND THERMAL EXPANSION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Thermal equilibrium exists between two bodies when their temperatures are such that no heat is exchanged between them.

T - F 2. An isochoric expansion process is one in which pressure does not change.

T - F 3. Absolute zero may be thought of as the temperature at which molecular motion would cease.

T - F 4. Differential expansion refers to different volume expansion rates of solids and liquids.

T - F 5. The density of an object decreases when the temperature decreases because this lowers the amount of mass in the object.

Match the following (6,7 and 8)

____6. Cold drink a) 477 K

____7. Hot coffee b) 88°C

____8. TV dinner (oven temperature) c) 505°R

9. A 55 gal drum of turpentine has its temperature rise from 5°C to 40°C. By how many gallons does the turpentine expand if the coefficient of volume expansion is $90 \times 10^{-5}/C°$?

a) 1.73 c) 4.2

b) 0.173 d) 0.84

10. Air is pumped into a tank at 60°C. The pump shuts off when gauge pressure reaches 150 lb/in^2. If the process is isochoric what will be the gauge pressure when the tank cools to 20°C? (Atmospheric pressure is 14.7 lb/in^2).

NAME_____

TEST C

Module T 1 TEMPERATURE AND THERMAL EXPANSION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Thermal Equilibrium exists between two bodies when their total internal energies are equal.

T - F 2. An adiabatic expansion process is one in which heat does not flow into or out of the system.

T - F 3. Absolute zero is approximately -460°C.

T - F 4. Solids always expand more than liquids over the same temperature range.

T - F 5. The density of a sample of water at 4°C will decrease whether the sample is heated or cooled.

Match the following (6,7 and 8):

____	6. Ice	a)	377 K
____	7. Water	b)	480°R
____	8. Steam	c)	50.5°C

9. How much does a 15 m railroad rail (steel) vary in length in centimeters from winter to summer if the temperature varies from -10°C to 40°C? The coefficient of linear expansion of steel is $11 \times 10^{-6}/C°$.

a) 0.49 c) 0.049

b) 0.0083 d) 0.83

10. The volume of an automobile tire is 2000 in^3. It has a gauge pressure of 30 lb/in^2. What volume would this air occupy at normal atmospheric pressure (14.7 lb/in^2) if the expansion is isothermal.

NAME_____

TEST D

Module T 1 TEMPERATURE AND THERMAL EXPANSION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Thermal equilibrium exists between two bodies when the average kinetic energies in each are equal.

T - F 2. An isobaric expansion process is one in which pressure does not change.

T - F 3. Absolute zero is approximately -273°C.

T - F 4. Water has its maximum density at 40°C.

T - F 5. Density is a property of matter that is constant for a given material. Density is unaffected by changes in temperature.

Match the following (6, 7 and 8)

____ 6.	Short sleeve blouse	a) 297 K
____ 7.	Sweater	b) 489°R
____ 8.	Overcoat	c) 10°C

9. A thermometer bulb contains 0.25 mℓ of mercury. What is the increase in volume of the mercury in milliliters when the temperature changes from 0°C to 100°C? The coefficient of volume expansion for mercury is $18 \times 10^{-5}/C$.

a) 0.011 c) 0.045

b) 0.0045 d) 0.08

10. A 800 mℓ sample of oxygen is collected in a laboratory at 27°C. What will be its volume if the temperature is lowered to 0°C isobaricly?

NAME_____

TEST E

Module T 1 TEMPERATURE AND THERMAL EXPANSION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. When two bodies are both in thermal equilibrium with a third body, they are not necessarily in thermal equilibrium with each other.

T - F 2. An adiabatic expansion process is one in which neither pressure or volume change.

T - F 3. Absolute zero is approximately -460°F.

T - F 4. Most solids expand less than most liquids over the same temperature range.

T - F 5. The density of solids and liquids changes with the temperature. However the change in density is not by a large percentage.

Match the following (6,7 and 8)

____ 6. Cold drink a) 361 K

____ 7. Hot tea b) 7°C

____ 8. Ice cream c) 470°R

9. A pyrex coffee pot holds 10 cups. Its linear cofficient of expansion is $3.2 \times 10^{-6}/C^{\circ}$. If cool water at 10°C is heated in the pot to 100°C, how much does the volume of the pot increase in cups?

a) 0.29 c) 1

b) 0.029 d) 0.0029

10. A 600 ml sample of oxygen is collected in a laboratory at 27°C. What will be its volume if the temperature is lowered to 0°C isobaricly?

TEST ANSWER KEYS

Module T 1 TEMPERATURE AND THEMAL EXPANSION

PROBLEM	A	B	C	D	E
1	T	T	F	T	F
2	F	F	T	T	F
3	F	T	F	T	T
4	T	F	F	F	T
5	F	F	T	F	T
6	c	c	b	a	b
7	a	b	c	c	a
8	b	a	a	b	c
9	c	a	d	b	d
10	37.6 lb/in^2	130 lb/in^2	6080 in^3	728 ml	546 mℓ

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

NAME _____

TEST A

Module T 3 TRANSFER OF HEAT

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. In order for heat to flow from one object to another, the two objects must be at different temperatures.

T - F 2. The coefficient of thermal conductivity has units of kcal/m s C° in the mks system.

T - F 3. Natural convection current depends on the fourth power of the temperature.

T - F 4. Good emitters of radiation are also good absorbers of the same kind of radiation.

T - F 5. Newton's law of cooling is true only if the temperature of the object is several thousand Celsius degrees above that of the surroundings.

6. The material with the lowest coefficient of conduction is:

a) lead c) a vacuum

b) water d) wood

7. Which method of heat transfer is most involved when fins and/or louvers (no fans or pumps) are used in industrial equipment such as the holes in the back of a TV set.

a) Conduction c) Forced convection

b) Natural convection d) Radiation

8. Find the total amount of heat energy in kilocalories that escapes through a window in one day if the heat current is 1000 W. (1 kcal/s = 4186 W)

a) 20 600 c) 8260

b) 344 d) 1000

9. The walls of a refrigerator are equivalent to 5 m^2 of 5-cm styrofoam (K = 0.000009 kcal/s m C°). If the interior temperature is 5°C and the outside is 20°C find the rate of heat transfer into the refrigerator.

OVER

10. A pepsi is taken from the refrigerator at 40°F. In 4 min its temperature is 45°F. Room temperature is 70°F. How much time is required for the pepsi to warm from 55°F to 60°F?

NAME _____

TEST B

Module T 3 TRANSFER OF HEAT

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Heat will always flow from an object containing a large amount of internal energy to one containing a lesser amount.

T - F 2. The coefficient of thermal conductivity has units of Btu in/ft^{2}h F$^\circ$ in the British system.

T - F 3. Natural convection involves the movement of a part of a liquid or gas which has a density that is different from the rest of the fluid.

T - F 4. An object that is a good absorber of radiation is usually a poor emitter of the same kind of radiation.

T - F 5. Newton's law of cooling is true only if the temperature of the object is not too much above or below that of the surroundings.

6. If three identical steel spheres (one blackened, one polished and one painted orange) are heated to the same temperature and set in a room, which will cool the fastest?

a) The painted one
b) They cool at the same rate
c) The polished one
d) The blackened one

7. Which method of heat transfer is most involved when such metals as copper, aluminum or silver are used in industrial equipment such as the copper used between the heating element and tip of a soldering iron.

a) Conduction
b) Natural convection
c) Forced convection
d) Radiation

8. A rate of heat flow of 1000 kcal/h is how many kilowatts? (1 kcal/s = 4186 W)

a) 4186
b) 4.186
c) 1.16
d) 0.86

OVER

9. A window has an area of 1.2 m^2. It is 4 mm thick. The inner surface temperature is 12°C and that of the outer is 9°C. If the coefficient of conductivity is 0.0002 kcal/s m C°, find the heat current through the window.

10. An electric motor operates at a temperature of 75°C when used indoors with an air temperature of 20°C. After being shut off, it cools to 70°C in 5 min. How much time is required for it to cool from 50°C to 45°C?

NAME _____

TEST C

Module T 3 TRANSFER OF HEAT

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Heat will always flow from an object at a high temperature to one at a lower temperature.

T - F 2. The coefficient of thermal conductivity has units of Btu ft/in^2 F°in the British system.

T - F 3. The rate of flow of heat being transferred by convection depends on the surface area of the heated object.

T - F 4. The rate of flow of heat by radiation depends on the surface area of the emitter.

T - F 5. Internal energy and heat are two names for the same thing and can be used interchangeably.

6. If three identical steel spheres (one blackened, one polished and one painted orange) are heated to the same temperature and set in a room, which will stay hot the longest?

a) The painted one
b) The polished one
c) The blackened one
d) They cool at the same rate

7. Which method of heat transfer is most involved in the transfer of heat from the filiment in a light bulb to the glass enclosure?

a) Conduction
b) Natural convection
c) Forced convection
d) Radiation

8. A new solid-state color TV set uses about 200 W of power. If the electrical energy is converted 100% to heat, how many kilocalories are produced in a 4 hour viewing period? (1 kcal/s = 4186 W)

a) 172
b) 4130
c) 690
d) 11.5

9. One-half inch copper pipe has an area of about 0.04 m^2 per meter of length. If water at 5°C flows through the pipe and the outside surface temperature is 5.2°C find the rate at which the water absorbs heat (K = 0.09 kcal/s m C°). The copper pipe is 2 mm thick.

10. An irrigation pump engine (diesel) has an average temperature of 180°F when it is shut off. It cools to 170°F in 7 min. How long will it take to cool from 150°F to 140°F? The outside temperature is 90°F.

NAME _____

TEST D

Module T 3 TRANSFER OF HEAT

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. There cannot be a net heat transfer between two objects that have the same temperature.

T - F 2. Conduction is the process in which heat energy is transferred by the motion of a gas or liquid.

T - F 3. Convection of heat from a surface does not depend on the area of the surface.

T - F 4. Black objects are the best absorbers but the poorest emitters of radiation.

T - F 5. The internal energy of a material is the total energy within it in the form of kinetic energy of the molecules and the potential energy of attraction between them.

6. If three identical steel spheres (one blackened, one polished and one painted orange) are placed in a deep-freeze overnight and set in a room, which one will warm up the fastest?

a) The painted one
b) The polished one
c) The blackened one
d) They warm up at the same rate

7. Which method of heat transfer is most involved in the transfer of heat in the combustion chamber of an engine to the coolant in the water jacket?

a) Conduction
b) Natural convection
c) Forced convection
d) Radiation

8. An older tube-type color TV set uses about 400 W of power. If the electrical energy is converted 100% to heat, how many kilocalories are produced in a 4 hour viewing period? (1 kcal/s = 4186 W)

a) 23
b) 1380
c) 344
d) 8260

9. A styrofoam cooler has 1 in. walls and a total area of 12 ft^2. If the inside surfaces averages 45°F and the outside averages 90°F, find the heat current into the cooler. (K = 0.23 Btu in h ft^2 F°).

10. Heat is lost through a wall at a rate of 1500 Btu/h when the temperatures of the inner and outer walls are 65°F and 25°F, respectively. What will be the loss in Btu per hour if the outside temperature drops to 0°F?

TEST ANSWER KEYS

Module T 3 TRANSFER OF HEAT

PROBLEM	A	B	C	D	E
1	T	F	T	T	F
2	T	T	F	F	F
3	F	T	T	F	F
4	T	F	T	F	T
5	F	T	F	T	T
6	c	d	b	c	b
7	b	a	d	a	d
8	a	c	c	b	a
9	0.0135 kcal/s 0.81 kcal/min 48.6 kcal/h	0.18 kcal/s 10.8 kcal/min	0.36 kcal/s 21.6 kcal/min	124 Btu/h 2.07 Btu/min	25 000 Btu/h
10	8.8 min	9.55 min	10.8 min	2440 Btu/h	12.4 min

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40

DATA SHEET

Module M 10 UNIFORM CIRCULAR MOTION

Step	8A	8B	8C	9	10
Quantity	Time for 15 rev (s)	Force (N)	Radius (m)	Angular velocity $\left(\frac{\text{rad}}{\text{s}}\right)$	Mass (g)
1					
2					
3					

Average mass (g) (Step 15)

Step 16 Mass of rubber stopper _____ g

Question is Step 16

Step 17 Error _____ %

TEST A NAME_____

Module M 10 UNIFORM CIRCULAR MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 9, circle your final answer. Be sure to include your name in the space provided.

T - F 1. An object is being whirled in a circle at the end of a string. If the string breaks, its inertia will cause it to "fly" off along a tangent to the circle at its location when the string breaks.

T - F 2. Angular distance is related to linear (arc) distance by the formula: $\theta = sR$

T - F 3. A radian is an angle at the center of a circle with an arc length equal to the diameter of the circle.

T - F 4. Centripetal and centrifugal are two different names for the same thing.

T - F 5. A particle in uniform circular motion has a non-zero acceleration even though its linear speed is constant.

6. A flywheel on a diesel tractor rotates 48 revolutions in 6 s. Its angular velocity in radians per second is:

a) 2π c) 100.5
b) 4π d) 50.3

7. A turntable rotates 0.75 revolutions in one second. What linear distance does the needle "travel" in one second? The groove is 3 in from the center of the record. (Answer in inches.)

a) 7.05 c) 28.2
b) 14.1 d) 2.25

8. Steel wire is being wound around some of the parts of a large generator armature to hold it together when it is in operation. The armature is in a lathe rotating at 50 rpm. If its diameter is 12 in, what length of steel wire will be used in 10 s?

a) 26.2 ft c) 1572 ft
b) 52.4 ft d) 6000 ft

9. A 10 g rock is wedged in a tread of an automobile tire. If the car is going 80 km/h, what centripetal force must the tread exert on the rock to keep it from "flying" off? Note: The tread of the tire is also going 80 km/h. The rock is 40 cm from the axis.

TEST B NAME_____

Module M 10 UNIFORM CIRCULAR MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 9, circle your final answer. Be sure to include your name in the space provided.

T - F 1. An object is being whirled in a circle at the end of a string. If the string breaks, inertia causes it to suddenly change directions so it "flies" radially outward from the center.

T - F 2. Angular velocity is related to linear velocity by the formula: $\omega = vR$.

T - F 3. An angle at the center of a circle has an arc length of 0.58 cm. If its radius is 0.29 cm, the angle is 2 rad.

T - F 4. Centripetal and centrifugal forces are an action-reaction pair of forces and act in opposite directions. They do not cancel since they do not act on the same object.

T - F 5. In a totally friction-free environment, a rotating object, once started, would continue to rotate forever.

6. A turntable rotates at 33 rpm. In radians per second, its angular velocity is:

a) 3.5 c) 7
b) 66π d) 6π

7. A flywheel on an automobile has a 16 in diameter. It rotates 35 revolutions in one second. How far does a point on the outer rim travel in feet in one second?

a) 560 c) 293
b) 46.7 d) 147

8. A large generator armature has a radius of 15 cm and is rotating at 1750 rpm. What is the linear speed of a point on its outer edge?

a) 1221 m/s c) 27.49 m/s
b) 2749 m/s d) 0.364 m/s

9. A car traveling at 55 mi/h (80.7 ft/s) rounds a curve with a 600 ft radius. What centripetal force must the road exert on the car if it weighs 4000 lb?

TEST C NAME_____

Module M 10 UNIFORM CIRCULAR MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 9, circle your final answer. Be sure to include your name in the space provided.

T - F 1. An object is being whirled in a circle at the end of a string. If the string breaks, the centripetal and centrifugal forces become zero. Friction, gravity, and the object's inertia and velocity determine its motion from then on.

T - F 2. Angular velocity is related to linear velocity by the formula: $v = \omega R$.

T - F 3. A radian is an angle at the center of a circle with an arc length equal to the circumference of the circle.

T - F 4. Centripetal force acts on the object traveling in circular motion and is directed toward the center of rotation.

T - F 5. Since work equals force times distance, a lot of energy is required to keep a rotating object going. Energy must be used to overcome the centripetal force.

6. A turntable rotates at 8.17 rad/s. Its angular velocity in revolutions per minute is:

a) 33 c) 78
b) 45 d) 16.5

7. A flywheel on an automobile has a 16 in diameter. A point on its outer rim travels 100 ft. How many revolutions are necessary?

a) 23.9 c) 47.8
b) 150 d) 75

8. An alternator armature rotates at 2000 rpm. In 5 s, it travels through an angular distance of:

a) 10 000 rad c) 6300 rad
b) 400 rad d) 1050 rad

9. A 5 kg mass is bolted onto a large flywheel as a counterweight. How much force must the bolts be able to withstand if the counterweight is placed 60 cm from the center of rotation? The flywheel turns at 300 rpm.

TEST D NAME _____

Module M 10 UNIFORM CIRCULAR MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 9, circle your final answer. Be sure to include your name in the space provided.

T - F 1. An object is being whirled in a circle at the end of a string. If the string breaks, centripetal force continues to act on the object until it comes to rest.

T - F 2. Angular distance is related to angular velocity by the formula: $\omega = \theta t$.

T - F 3. An angle at the center of a circle has an arc length of 0.36 m. If its diameter is 0.18 m, the angle is 2 rad.

T - F 4. Centrifugal force acts on the object traveling in circular motion and is directed toward the center of rotation.

T - F 5. No work is required (neglecting friction) to keep a rotating object going since centripetal force is perpendicular to the direction of motion.

6. A flywheel on an automobile engine rotates at 314 rad/s. What is its angular velocity in revolutions per minute?

a) 3000 c) 50
b) 1500 d) 4500

7. Thirty centimeters of V-belt rolled over a pulley. If the pulley has an 8 in diameter, what angle did it turn through?

a) 7.5 revolutions c) 1.19 rad
b) 1.19 revolutions d) 3.75 rad

8. A turntable rotates at 33 rpm. At what linear velocity does a point on the record move past the needle if the point is in a groove 15 cm from the center?

a) 51.8 cm/s c) 3170 cm/s
b) 495 cm/s d) 104 cm/s

9. The crest of a hill has a radius of curvature of 240 ft in a vertical plane. A 4000 lb automobile goes over the hill at 55 mi/h. What centripetal force acts on the car? (55 mi/h = 80.7 ft/s)

TEST E NAME_____

Module M 10 UNIFORM CIRCULAR MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problem 9, circle your final answer. Be sure to include your name in the space provided.

T - F 1. An object is being whirled in a circle at the end of a string. If the string breaks, the centripetal force immediately becomes zero. The objects motion from that time on is determined by friction, gravity, and its own inertia.

T - F 2. Angular distance is related to angular velocity by the formula: $\theta = \omega t$.

T - F 3. An angle at the center of a circle has an arc length of 0.76 in. If its diameter is 0.76 in, the angle is 2 rad.

T - F 4. Centrifugal means "outward from the center" while centripetal means "toward the center."

T - F 5. A particle in uniform circular motion has an acceleration parallel to the direction of motion at any instant.

6. A flywheel on a tractor engine rotates 54 revolutions in 6 s. In radians per second, the angular velocity is:

a) 3π c) 18.9
b) 18π d) 37.7

7. An electric motor rotates 28.7 revolutions in one second. What linear distance in feet does a segment of wire on the outer edge of the armature travel in one second? The diameter of the armature is 3.5 in.

a) 26.3 c) 100
b) 631 d) 52.6

8. A V-belt pulley rotates at 450 rpm. In 3 s, it travels through what angular distance?

a) 22.5 rad c) 141 rad
b) 1350 rad d) 1410 rad

9. An electric motor runs at 1750 rpm. What is the centripetal force on a small segment of conductor on the outer edge of the armature? It has a mass of 3.24 g and is located along a line parallel to and 12 cm from the axis.

TEST ANSWER KEYS

Module M 10 UNIFORM CIRCULAR MOTION

PROBLEM	A	B	C	D	E
1	T	F	T	F	T
2	F	F	T	T	F
3	F	T	F	F	T
4	F	T	T	F	T
5	T	T	F	T	F
6	d	a	c	a	b
7	b	d	a	a	a
8	a	c	d	a	c
9	1 230 000 dynes or 12.3 N	1360 lb	2960 N	3390 lb	1 310 000 dynes or 13.1 N

GRADING

NUMBER WRONG	GRADE
0	100
1	89
2	78
3	67
4	56
5	45
6	34

DATA SHEET

Module W 1 WAVE MOTION

Experiment A REFLECTION

Step 11 i = _____° r = _____°

Step 12 error _____%

Experiment B REFRACTION

Step 11 i = _____° _____° average_____

Step 12 r = _____° _____° average _____°

Step 13 n = _____ error_____%

NAME_____

TEST A

Module W 1 WAVE MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. There is essentially no difference between transverse and longitudinal waves.

T - F 2. The distance from crest to crest of a wave is called its period.

T - F 3. The smaller the period of a wave, the shorter the wavelength (velocity constant).

T - F 4. The range of frequencies heard by a young (normal) person is about 20 Hz to 20 000 Hz.

T - F 5. The loudness of a sound depends on its frequency.

6. Green light of 5000 A° wavelength has an equivalent wavelength of:

a) 5×10^{-8} m

b) 5×10^{2} nm

c) 5×10^{-10} cm

d) 5×10^{-7} mm

7. KFAB radio (Omaha, Ne) broadcasts on a frequency of 1110 kHz. The wavelength of the waves is: ($c = 3 \times 10^{8}$ m/s)

a) 270 m

b) 270 km

c) 3.33×10^{14} m

d 3.7×10^{-3} m

8. If the angle of refraction is 25° for an angle of incidence of 40°, the index of refraction is:

a) 1.60

b) 0.63

c) 1.52

d) 0.66

9. A wave is given by the equation: $y = 10^{-9} \sin 80\pi(t - 5.376 \times 10^{-6}x$ with distance and time in miles and seconds, respectively. What is the wave velocity?

OVER

10. What minimum speed of rotation is necessary for an eight-sided mirror used in measuring the speed of light (186 000 mi/s) using Michelson's apparatus? The distance from the stationary mirror to the rotating one is 22 mi.

NAME _____

TEST B

Module W 1 WAVE MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. In a longitudinal wave, the individual particles move perpendicular to the direction the wave is traveling.

T - F 2. One-half the distance from peak to trough of a wave is called its amplitude.

T - F 3. The longer the wavelength of a wave, the higher the frequency (velocity constant).

T - F 4. The range of frequencies heard by a young (normal) person is about 20 Hz to 2000 Hz.

T - F 5. The color of a light wave depends on its frequency.

6. Red light of 7000 A° wavelength has an equivalent wavelength of:

a) 7×10^{-4} mm

b) 7×10^{-10} m

c) 7×10^{-9} mm

d) 7×10^{-7} cm

7. KSRD-FM radio (Seward, Ne) broadcasts on a frequency of 96.9 MHz. The wavelength of the waves is:

a) 3096 km

b) 3096 m

c) 2.907×10^{13} m

d) 3.23×10^{-4} m

8. The index of refraction of water is 1.33. Find the critical angle.

a) cannot be determined

b) 53.1°

c) 41.3°

d) 48.8°

9. A wave is given by the equation: $y = 3.5 \sin 86\pi (t - 0.007 x)$, with distance and time in centimeters and seconds, respectively. What is the amplitude?

OVER

10. If the minimum speed of rotation is 600 rev/s using Michelson's apparatus for measuring the speed of light (3×10^8 m/s), find the distance from the rotating mirror to the stationary mirror. An eight-sided mirror is used.

NAME_____

TEST C

Module W 1 WAVE MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. In a transverse wave, the individual particles move perpendicular to the direction the wave is traveling.

T - F 2. The distance from peak to trough of a wave is called its amplitude.

T - F 3. The longer the wavelength of a wave, the smaller the period (velocity constant).

T - F 4. The range of wavelengths of visible light is about 3800 A° (violet) to 7800 A° (red).

T - F 5. The pitch of a sound wave depends on its frequency.

6. Blue light of 480 nm wavelength has an equivalent wavelength of:

a) 4.8×10^{-10} m

b) 4.8×10^{-5} mm

c) 4.8×10^{-7} cm

d) 4.8×10^{3} A°

7. KWHG-FM radio (Lincoln, Ne) broadcasts on a frequency of 106.3 MHz. The wavelength of the waves is: ($c = 3 \times 10^{8}$ m/s)

a) 2822 km

b) 3.19×10^{13} m

c) 2.822 m

d) 3.54×10^{-9} m

8. If the angle of incidence is 35° on a glass surface with an index of refraction of 1.5, the angle of refraction is:

a) 59.4°

b) 22.5°

c) 52.5

d) 23.3

9. A wave is given by the equation: $y = 2 \sin 966\pi(t - 0.01x)$, with distance and time in centimeters and seconds, respectively. What is the frequency of the wave?

OVER

10. What minimum speed of rotation is necessary for a twelve-sided mirror used in measuring the speed of light (3×10^8 m/s) using Michelson's apparatus? The distance from the stationary mirror to the rotating mirror is 30 km.

NAME_____

TEST D

Module W 1 WAVE MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter. In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. In a longitudinal wave, the individual particles move parallel to the direction the wave is traveling.

T - F 2. The distance from crest to crest of a wave is called its amplitude.

T - F 3. The longer the wavelength of a wave, the lower the frequency (velocity constant).

T - F 4. The range of frequencies heard by a young (normal) person is about 20 Hz to 200 kHz.

T - F 5. The brightness of a light wave and the loudness of a sound wave both depend on the intensity.

6. Violet light of 4000 A° wavelength has an equivalent wavelength of:

a) 4×10^{-8} m

b) 4×10^{2} nm

c) 4×10^{-10} cm

d) 4×10^{-7} mm

7. KLIN radio (Lincoln, Ne) broadcasts on a frequency of 1400 kHz. The wavelength of the waves is: (c = 186 000 mi/s)

a) 7.53 mi

b) 1.37×10^{15} ft

c) 132.9 mi

d) 701.5 ft

8. The critical angle in a certain plastic is 45°. What is the index of refraction?

a) 0.71

b) 1.00

c) 1.41

d) can't be calculated

9. A wave is given by the equation: $y = 2 \sin 428\pi(t - x/500)$, with distance and time in centimeters and seconds, respectively. What is the period?

OVER

10. What minimum speed of rotation is necessary for an twelve-sided mirror used in measuring the speed of light (186 000 mi/s) using Michelson's apparatus? The distance from the stationary mirror to the rotating one is 22 mi.

NAME_____

TEST E

Module W 1 WAVE MOTION

Read each question carefully and decide which one of the answers is best. Notice what letter your choice is. Then, circle the letter In problems 9 and 10 circle your final answer. Be sure to include your name in the space provided.

T - F 1. Both longitudinal and transverse waves transport energy.

T - F 2. The wavelength is the distance in the direction of wave travel between two successive particles that are vibrating in phase.

T - F 3. The shorter the wavelength of wave, the lower the frequency (velocity constant).

T - F 4. The range of wavelengths of visible light is about 3.8×10^{-5} m (red) to 7.8×10^{-5} m (violet).

T - F 5. The color of a light wave depends on its amplitude.

6. Orange light of 630 mm wavelength has an equivalent wavelength of

a) 6.3×10^{3} A° c) 6.3×10^{-7} m

b) 6.3×10^{-5} cm d) all of these

7. KMMJ radio (Grand Island, Ne) broadcasts on a frequency of 750 kHz. The wavelength of the waves is : (c = 186 000 mi/s)

a) 1309 ft c) 248 mi

b) 4.03 mi d) 7.37×10^{14} ft

8. The angle of incidence is 40° on a glass surface. What is the angle of reflection?

a) 60° c) 20°

b) 40° d) can't be calculated

9. A wave is given by the equation: $y = 10^{-3} \sin 1024 \pi(t - x/3.4 x$ with distance and time in centimeters and seconds, respectively. What is the wavelength?

OVER

10. If the minimum speed of rotation is 600 rev/s using Michelson's apparatus for measuring the speed of light (3×10^8 m/s), find the distance from the rotating mirror to the stationary mirror. a twelve-sided mirror is used.

TEST ANSWER KEYS

Module W 1 WAVE MOTION

PROBLEM	A	B	C	D	E
1	F	F	T	T	T
2	F	T	F	F	T
3	T	F	F	T	F
4	T	F	T	F	F
5	F	T	T	T	F
6	b	a	d	b	d
7	a	b	c	d	a
8	c	d	b	c	b
9	186 000 mi/s	3.5 cm	483 Hz	4.67×10^{-3} s	66.4 cm
10	528 rev/s	31.3 km	417 rev/s	352 rev/s	20.8 km

GRADING

NUMBER WRONG	GRADE
0	100
1	90
2	80
3	70
4	60
5	50
6	40